Devoted to
TEXTILE
CHEMISTRY
BLEACHING
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AUGUST 25, 1947
VOLUME 36, No. 17

AMERICAN DYESTUFF REPORTER

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SEP 2

Never were there such whites...

obtainable on cotton, viscose rayon and linen fibres before the advent of Geigy's

TINOPAL B V A *

Introducing an entirely new physical (optical) principle, an intensive fluorescence is created without dulling the shade; rather is the reflected white light increased incomparably.

This is more readily understood when it is considered that Tinopal BVA is not a common pigment bluing agent, but rather a substantive colorless product. Consequently it does not *add* a blue coloring matter to a yellow ground, resulting logically in a greyish shade and a loss in reflected light.

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of the
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OF TEXTILE CHEMISTS
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Industrial Chemicals Division

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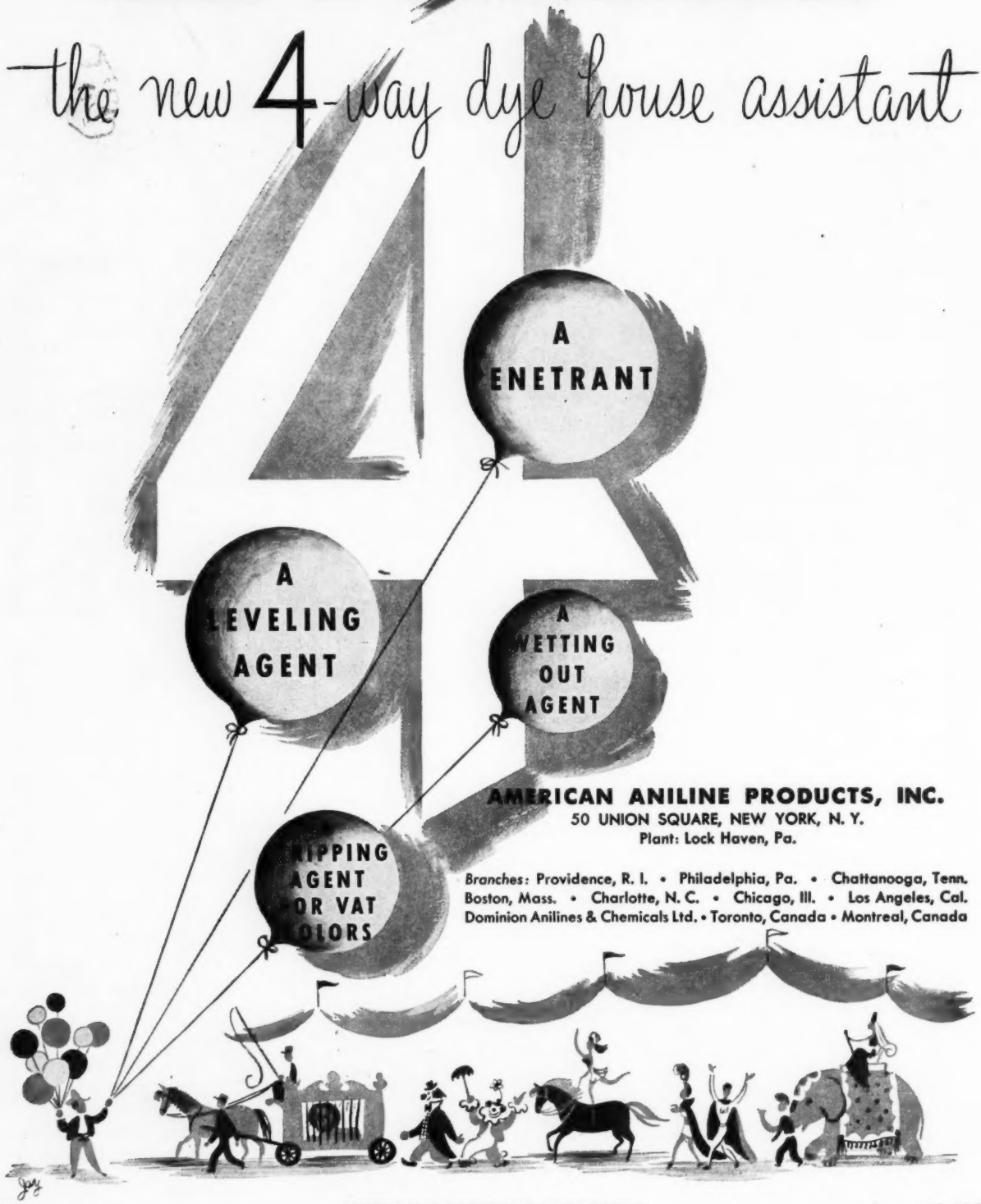

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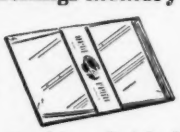

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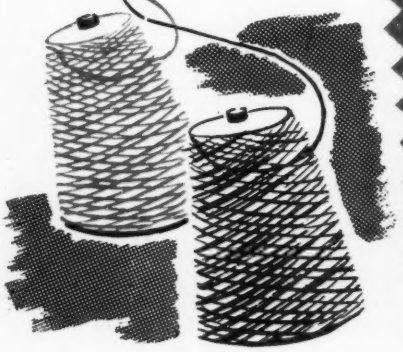
PYROTEX is a most effective scouring agent having excellent wetting out properties which assures immediate scouring action.

PYROTEX can be used in scouring and dyeing of wool, worsted, rayon, acetate, cotton and nylon.

PYROTEX is not affected by acid, alkali or hard water, and will not precipitate or form scum.

PYROTEX, being neutral, is very adaptable for dyeing of acetate and mixtures thereof.

PYROTEX can be used alone or with soap and alkalies. In scouring of woolens and worsteds for piece goods dyeing, it is extremely important that goods be thoroughly free from fats which may cause shaded or cloudy goods. When using PYROTEX, even if not thoroughly washed out, it will not be affected by dyeing, but will be an assistant in the dyeing.



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- Normal pH limits 4.5-6; accepts alkaline materials to pH 12

X-56-L is outstanding because of the *high softening point* and *water resistance* of the resin, giving

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X-56-L is outstanding because of its *low cost,* giving

- Economical results, especially in view of the qualities imparted to the fabric

Further details are given in our Technical Bulletin E-2. Write for your copy today.

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WOOL: Pine Solvent XX is valuable in raw-wool scouring . . . irreplaceable in fulling. From the raw stock it produces clean, soft, really white wool in prime condition for storage or further processing. In the fulling mill, it cuts time as much as 30% . . . costs no more . . . helps you meet contract delivery dates on time.

RAYON: In boiling off, Pine Solvent XX rapidly emulsifies gelatinous materials . . . is safe for the most delicate fabrics. Used in dyeing, it makes the fabrics wet out and sink quickly.

DYEING: Pine Solvent XX makes dye liquor penetrate the hardest fibers and heaviest seams. It gives an even, level deposit of dyestuff of uniform depth throughout every fiber. Loose dyestuff and impurities are suspended for washing out completely.

PRINTING: In printing paste, Pine Solvent XX wets pigments thoroughly, disperses them evenly, and holds them in suspension without agglomeration and until the design is on the fabric. Designs are sharp, colors bright and clear, no specks are formed.

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Clearer, more even dyeing, *faster* with *Laurel* WOOL SCOURING COMPOUNDS

YOU are sure of clean, soft wools and worsteds, clearer, more even dyeings when you use Laurel Scouring Compounds. Known for their speedy detergent action and used by leading mills for over thirty-five years, Laurel Scouring Compounds remove grease, oil, dirt quickly, economically, without injury to fibers. Keep mineral oils in suspension. Leave wool lofty and with soft hand . . . level dyeing. Available now. Send for trial order today. Let Laurel Scouring Compounds help you improve quality production and deliveries.

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IT'S TRUE...
IF MOUNT EVEREST, WORLD'S HIGHEST PEAK, WERE SUNK IN THE DEEPEST PART OF THE OCEAN (THE MINDANAO TRENCH OFF THE PHILIPPINES) ITS TOP WOULD BE MORE THAN 6000 FEET BELOW SEA LEVEL!

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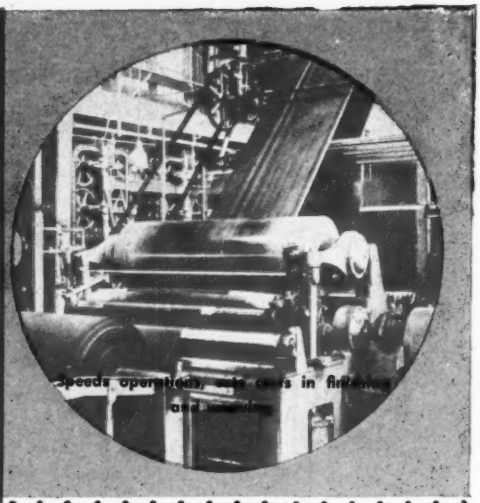
STYMER

a totally new sizing and finishing agent for rayons, cottons and worsteds



In actual mill practice, Stymer—a new Monsanto development for the textile industry—has already proved itself *two to three times more effective* than former sizing agents on acetate rayon, viscose rayon, cotton and worsteds. Its application requires no special equipment. It has many new, practical working advantages over former sizing agents. It competes on a cost basis.

MANY ADDITIONAL USES

In addition, Stymer possesses nearly a score more useful qualities, that make its announcement welcome news in textile mills. Chief among them are these four: (1) Stymer has excellent filament and fiber bonding qualities, (2) it reduces or eliminates static in weaving, (3) its weaving properties are practically independent of humidity or temperature changes, (4) as a finishing agent for cottons and rayons, Stymer assures unique, bright crisp fabric.

TIMELY DEVELOPMENT

The introduction of Stymer is of special interest at this time, when competition is becoming increasingly tough from the standpoint of both price and quality. It gives far-seeing textile firms an opportunity to improve their products and to cut manufacturing costs in order to compete successfully under today's difficult market conditions.

QUICK FACTS ABOUT STYMER FOR SIZING

1. Excellent filament and fiber-binding qualities.
2. Not affected by temperature changes—may be applied from a size bath or temperatures of 140° F to 212° F with equal ease.
3. Stymer sizing films maintain their toughness at high humidity and flexibility at low humidity.
4. Eliminates or minimizes static in slashing and weaving.
5. Does not shed on acetate and filament yarns.
6. Produces softer, well-sized yarn.
7. Broken filaments in warp are picked up.
8. Does not stick to dry cans under proper application.
9. Produces more uniform fabrics.
10. Size is easily removed with plain water.
11. Will not "set" in mill pipes, does not gel when cold.
12. Economical to use.

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Stymer: Reg. U. S. Pat. Off.

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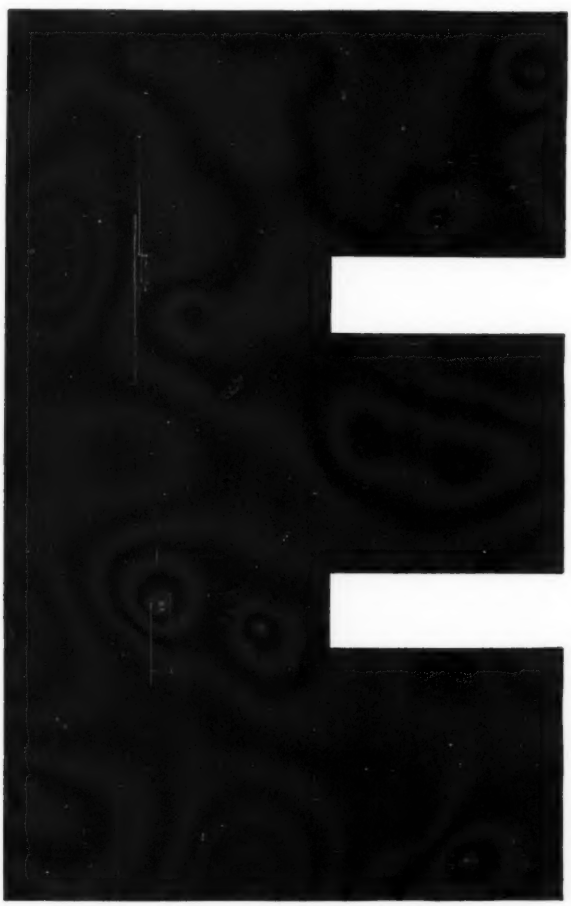
EASTMAN BLACK SN NEW is a highly refined soluble dye base. Diazotized and developed with beta-oxy-naphthoic acid, it dyes acetate rayon a dense neutral shade of black which retains its cast under both daylight and artificial light. It dyes nylon a slightly greener shade.

When heated with direct steam, Black SN New will not tar in a water medium. It is highly recommended for cross-dyeing, since it stains viscose rayon and cotton only slightly. At low temperatures, it penetrates and levels well with good exhaustion of the dyestuff. Blacks obtained by either jig or box method meet general commercial fastness requirements and offer exceptional resistance to sublimation and crocking.

Eastman Acetate Dyestuffs are available in a wide variety of useful colors especially developed for cellulose acetate rayon. Additional information concerning these dyestuffs can be obtained by writing to TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.



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ACETATE DYESTUFFS

ONYX IONICS

Newsworthy Items for Textile Technologists and Production Men

August, 1947

The New Onyx House Organ

Just off the press, the first issue of our new house organ, "Onyx Ionics," is now being mailed to those of you who asked to be put on the mailing list as a result of previous mention in our advertising.

This 4-page publication is chiefly devoted to practical field applications and test data

on Onyx products as used in the textile field. We think you will find it informative and useful as a source of new processing ideas.

If you have not already done so, may we suggest that you write, asking us to put your name on the mailing list for the current copy of "Onyx Ionics" and future issues? Please feel free to include the names of any others in your organization who might be interested.

Faster Wool Carbonization

If you can increase the wetting and penetrating action of your carbonizing acid, you can materially improve carbonizing speed and effectiveness. Onyx NSAE Paste is a highly effective anionic wetting agent with the unusual property of being stable to carbonizing acids.

There is no change in the mode of treatment. The only difference is the addition of ½% NSAE Paste (based on the acid content) to the acid bath. As the bath decreases in volume, fresh acid solution treated with NSAE Paste in the same proportions, is added.

An extremely effective wetting agent in high concentrations, NSAE Paste is also used as an auxiliary for levelling acid colors in wool, and in the pasting up of all classes of dyes.

For a Durable Crush-Proof Finish on all Types of Rayon and Cellulose Fabrics

NEW DEVELOPMENTS

For Further Details Write Onyx

Need an Auxiliary Detergent to Combat Hard Water? Investigate Neutronyx 330—the ***non-ionic*** surface-active agent with outstanding emulsifying, dispersing and detergent characteristics. No. 63

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For Dull, Soft Shades on Light and Medium Colors Onyx Dullatone CA is particularly effective. This cation-active dispersible titanium dioxide is highly valuable in dulling and softening all types of rayon, acetate and nylon piece goods. No. 64

Eternalure—the One Treatment Finish for Nylons—imparts snag resistance and body while tightening and clarifying the stitch. Easy to use without changes in equipment and operations. Eternalure insures easy handling after boarding and materially reduces pull threads. No. 65

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Durable, Low Cost Water Repellency on Rayon-Cotton, Acetate-Cotton and many all Rayon and Acetate constructions is insured by the use of Repel-O-Tex D3 and D4. These complementary materials also provide effective repellency of considerable durability on other textiles. No. 66

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Dry Cleaning and Laundry-Resistant Moth Proofing is obtained by using cation-active quaternaries Imularv P (used in water solution) or Imularv S (used in organic solvents). No. 67

Onyx NCF Paste is a urea-formaldehyde condensation product with a broad range of usefulness in treating all types of cellulose fabrics. Used principally for crush-proofing, NCF Paste also provides interesting variations in "springy" hands. It can be most effectively used to reduce shrinkage in spun rayon fabrics. Another interesting application is for insolubilizing certain protein finishes for fabrics. All these effects are *durable.* NCF Paste is usually applied in the mangle or padder. The fabric should be fully impregnated with the NCF solution at recommended concentration, and then squeezed between the rolls to obtain a retention by weight of from 75 to 100% on the weight of the goods.

In providing crush resistance where a high concentration is used, pressure on the pad or mangle should be from 3-5 tons, in order to insure proper penetration and to prevent

too high a concentration of surface deposits.

After drying on the tenter frame or in the dry box, goods are cured by a 3-5 minute bake at 310-325°F.

For complete data on NCF Paste, write for Technical Bulletin 8-T.

For Permanency in Softening . . . Onyxsan LG

Onyxsan LG is distinctive in the durability of the finish it imparts in the unusually smooth, "drapey" hand it provides. Cationic softening with Onyxsan LG gives you a *permanent* effect on all types of cotton, rayon, acetate and bemberg textiles. It also gives hand of excellent pliability and desirable durability to aralac, silk, wool and mixed constructions of these fibers.

The finish Onyxsan LG produces is due to properties produced within the yarn. It is substantive to textile fibers, acting like a dyestuff and making itself a part of the fiber.

Easy to apply in print washer, jig, dye beck, quetsch or starch mangle, Onyxsan LG requires very small quantities to produce its characteristic effects. For complete data, write for Technical Bulletin 9-T.

A Much Superior Sulfonated Tallow

Onyx Stearo Glyceryl Sulfate N has a much higher SO_3 content than ordinary sulfonated tallows. It has a much greater resistance to hard water and electrolytes. It is also much more readily soluble. Widely used as a lubricant and softening agent, Stearo Glyceryl Sulfate N offers outstanding resistance to yellowing and rancidity in treated fabrics.

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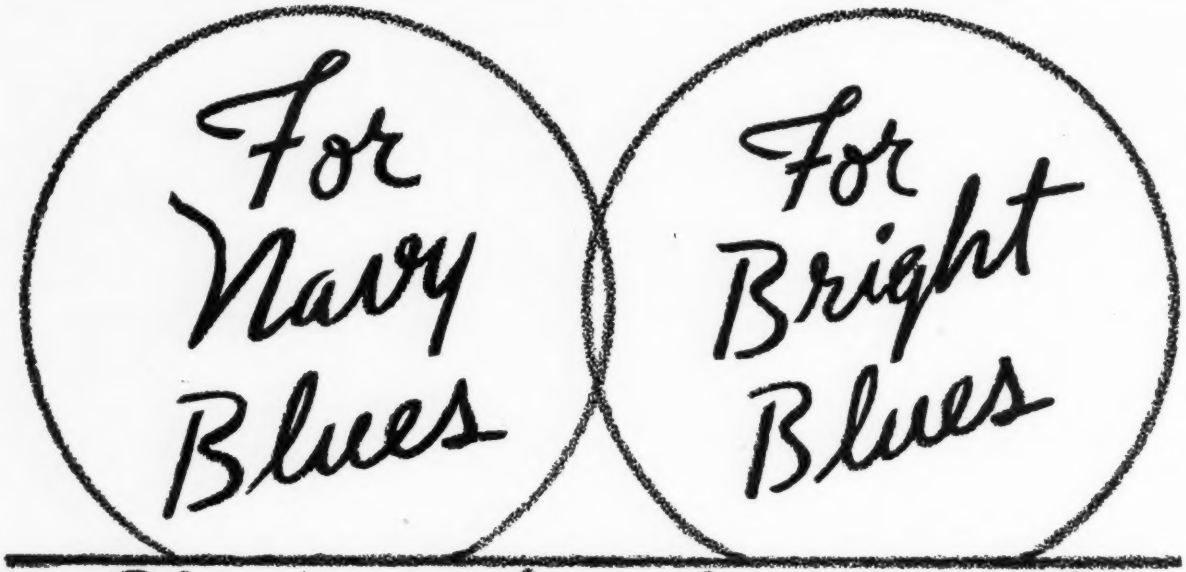

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Blue GNXX
Blue GDNN

THESE azoic colors, for printing cotton, linen or rayon, produce Navy Blue of good fastness at a low cost. In combination with the Pharmasol Yellows they produce deep Browns.

PHARMASOLS are stabilized solutions, adjusted to the most practical concentration, which can be easily applied with a maximum of efficiency.

PHARMASOLS do not decompose and thereby they overcome the otherwise problems of troublesome dissolving.

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THE outstanding soluble vat color for producing bright Blues in any depth, of excellent fastness, is Indigosol Blue IBC. It is suitable for dyeing, padding and printing on cotton, linen or rayon (excepting acetate fibers) where maximum fastness is required.

Indigosol Blue IBC is an important member of the group of very fast Indigosols, all of which are readily soluble and easily developed.

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August 25, 1947

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Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Special Articles

Studies on Detergent Power 457
J. P. Sisley (Translated by P. J. Wood)

Friction Between Keratin Surfaces as Affected by Some Shrinkproofing Treatments 470
M. Lipson and P. Howard

Felt Resistant Wool by Wet Chlorination 473
Harry Zimmerman

• Departments

Patent Digest 466
Paul Wengraf

Index to Patent Digest 467

Abstracts from Contemporary Journals 476

Trade Notes—New Products 477

• Proceedings of the American Association of Textile Chemists and Colorists

Silver Anniversary, Philadelphia Section P481

Fall Meeting, Piedmont Section P481

Meetings, New York Section P481

Section on Standard Soils P481

South Central Research Committee P481

Calendar P481

Employment Register P481

Questions Answered by Experts at Philadelphia Meeting P482

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Studies on Detergent Power*

J. P. SISLEY

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The author enumerates the different factors on which detergent power depends, and studies the mechanism of the action of the products used; he would not include in a single definition or follow the same method of determination of detergent power for the treatment of the various textile fibers, utensils soiled by their contents, the skin, greasy metals, etc. In the case of textile fibers, there are as many degrees of detergent power as there are fibers to be cleansed. Methods of determination of detergent power, adapted to the different fibers to be treated and the type of soil to be removed are reviewed according to the various textile processes: laundering, wool scouring, hair cleasing, degumming of silk, kiering of fibers of vegetable origin and boiling-off of rayons.

WE talk a great deal about things of which we are ignorant. This is why the question of detergent power is timely. It is annoying to realize that its importance is in inverse relation to our possibilities in the domain of detersives.

Active Factors in Detergent Power

It is easy to list the factors on which detergent power depends; they are as follows:

1. Wetting power
2. Foaming power
3. Emulsifying power
4. Dispersing or deflocculating power.
5. Solvent power
6. The power to protect against redeposition.
7. Resistance to lime salts (hard water).

The mechanism of the manifestations of detergent powder depends on other variables:

1. Nature of the detergent.
2. Nature of the surface to be cleansed.
3. Nature of the impurity or soil to be removed.
4. Nature of the water employed.
5. Effect produced on the surface to be cleansed.

The efficacy of the detergent depends on

(a) its chemical composition
(b) its concentration
(c) the temperature
(d) the nature of mechanical treatment applied.

These factors are not numbered in order of importance, so let us rest on the defintion of the group, whilst limiting ourselves to consideration of the effect they produce.

If we consider the case of textile fibers, the effect depends on three elements: the solution, the fiber, the impurities present.

Penetration appears to be the most important factor; the process may be described as follows:

Fabrics consist of a mass formed of large capillaries and, between the threads, fine interstitial surfaces, where the impurities are partly on the surface and partly in the interior. The capillary system contains occluded air. In order to penetrate and wet all parts of the fabric, this air must be eliminated by the action of the wetting agent. The impurities are detached from the fiber by the relatively greater attraction of the detergent solution as compared with that of the greasy soil for the fiber. There is diminution of the angle of contact between the interface of the oil and the water and the surface of the fiber. This value can be determined by the method of Adam (*1*). Emulsifying power intervenes to a certain extent in diminishing the size of the oil globules. These are acted upon by the solvent effect of the detergent, leading to saponification of the fatty matters. The unsaponifiable oils being emulsified, the dispersing power and the particular structure of the detergents makes it possible to keep them in suspension and prevents their re-deposition.

1. Wetting power.—The surface of contact between a liquid phase and a gaseous phase constitutes the seat of a particular type of energy which is called "surface energy."

If a definite unit of length is measured off on the surface of a liquid, it is found to be subject to a certain force which is called "surface tension."

All substances which, when dissolved in water, either in true or colloidal solution, tend to reduce surface tension are considered to be wetting agents.

The diminution of surface tension produced by a wetting agent, e.g. soap, corresponds to a higher concentration in the surface layer than in the body of the liquid itself.

This property has the effect of conferring on the liquid the ability to form froth and is found to be connected with foaming power.

Most frequently, the surface tension of a liquid is measured in contact with air or with its own vapor, but it is also possible to measure the surface tension of two immiscible liquids at their surface of separation. One then obtains what is known as the "interfacial tension" of the two liquids.

Soaps and modern detersives act, generally, as reducers of surface tension, promoting wetting and penetration.

2. Foaming power.— Foaming power, considered as an essential factor in the

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action of detergents, comes particularly into play when the merchandise to be treated circulates into and out of the bath. Foam possesses a very great surface tension having an accumulation of active substances on its surface. The foam is richer in soap than the soapy solution which gives rise to it. This concentration is further intensified by contact with the tensioactive surfaces of the fibers. A typical example is shown in the degumming of silk by the foam method of Schmidt. Whilst it is true that most detergents are endowed with a high degree of foaming power, it does not follow that all substances which foam are effective detergents. Some additions having no influence on detergency, or, on the other hand, having much influence, may sometimes increase foaming and at other times reduce it. When a few drops of an anti-foaming compound, such as tributyl phosphate, is added to a soap solution the detergent power of the soap solution remains unchanged.

3. Emulsifying power.—An emulsion is formed of extremely small particles of a liquid, dispersed in another liquid with which it is immiscible. The formation of the emulsion is due to the lowering of the surface tension between the two liquids being mixed corresponding to a tremendous increase in the surface contact between them. In the case of oil and water, there is no emulsion formed when the two are agitated together as the surface tension between the two liquids is too high. If one adds a substance which lowers the surface tension, soap for instance, an emulsion will be produced. Every substance, soluble in water, lowering the surface tension of contact between water and oil facilitates the emulsion of oil in water; every material soluble in oil and lowering the surface tension makes possible the formation of the emulsion of water in oil. The reduction of surface tension is accompanied by a change in concentration, the soap concentrates on the surface where the surface tension is exerted. This absorption on the surface of the minute globules of oil, of the particles forming the dispersed phase, produces a sort of protective film which prevents the globules of the emulsion from reuniting and stabilizing. Certain emulsifying agents, like soap, act at the same time as colloids and reducers of surface tension.

The experiments of Robinson have shown that substances which act as detergents emulsify mineral oil, olive oil and lanolin at much lower concentrations than are necessary to remove these same oils from textiles. The removal of oil from the fiber which depends on the power of emulsification is therefore an important factor of detergency. Oil can be removed from the fiber without being emulsified, but there is a risk that it may be redeposited. On the other hand, as Hartley has shown, if the fatty impurity is put into a state of very fine emulsion, it can be reabsorbed into the micelles of the fiber from which it can not easily be eliminated.

4. Dispersing and deflocculating power.—Dispersing power depends on a combination of phenomena due to the particular properties of colloids and relating to the unequal distribution of matter at the surface of separation of two media. In the case of soap or modern detersives, this phenomenon is manifested as colloidal action. In the case of fibers and solutions, it is an action of the colloid on solid particles. In the case of mineral impurities and liquid detergents, it is a manifestation of the action of fine colloidal particles on the surface of coarser particles. In the case of products having the effect of protective colloids, one notes a stabilizing action preventing mass action of electrolytes and flocculation. Deflocculant power, so vital in the elimination of soil, depends on this combination of phenomena and also on the structure of the reagents.

5. Solvent power. — Solvent power works on the fatty matters and albumenoids by saponification or hydrolysis. In the case of added solvents, the reaction is merely solubilizing.

6. The power to protect against redeposition.—In practice, the action of a detergent consists, not only in freeing the material to be cleansed from all soil, but to prevent the return of the soil to the surface being cleansed. This point, which is frequently passed over in silence, renders the problem more complex, taking for granted that the best conditions for removal of soil are not always those which are necessary for preventing redeposition of the soil. The property of a detergent solution which opposes this redeposition is called power of suspension.

Tests to measure the power of suspension are generally based on the proposition of sedimentation produced, under certain fixed conditions, or particles suspended in a solution of the detergent. J. Rowney and R. W. Noad have studied the power of suspension by measuring the ability of a detergent to prevent solid particles from adhering to the surface of a fabric under conditions created by mechanical action, so that sedimentation caused by gravity ceases to be a dominant factor. The method consists in measuring photometrically the dulling of shade produced on fabrics shaken up in a suspension of solid particles.

Protective power against redeposition is often ignored and the cleansing consists in dispersing the dirt throughout the body of the fabric, in order to give it a more agreeable appearance to the eye. It depends on dispersing power, the structure of the reagents and the nature of added detergents acting like solvents.

The phenomena of hydrolytic dissociation play a leading role in the case of soap. By this hydrolysis are formed a strong anion and a weak cation; these anions are absorbed by molecules of soap not dissociated with formation of a colloidal anion complex, negatively charged:

$(X.CH_3\text{-}CH_2 \ldots\ldots\ldots COONa)y-$
$(Y.CH_3\text{-}CH_2 \ldots\ldots\ldots COO)yNa+$

These anion complexes are always found in a soap solution. They tend to be adsorbed by the most diverse substances which they surround with a negatively charged surface. After the dirt has been removed by the action of wetting, the particles are adsorbed by the colloidal anion complex and carried away from the fiber. It has long been thought that the power to protect against deposition was linked with foaming power; This is not the case, as this property depends on dispersing power and on molecular dissociation. As a matter of fact, cation active bodies have also the property of detaching dirt, but the particles are adsorbed by the active cation while taking a positive charge. They are precipitated in the form of positively charged colloidal ions.

Thus one obtains an effect reversed to that obtained in the cleansing with anion active substances, soaps and modern detergents. Soap solutions, by means of their active anions, recover the particles of dirt from a negatively charged surface, thanks to which fact these particles are generally more or less repelled by textile fibers.

7. Resistance to lime salts.—Resistance to lime salts differentiates soaps and the modern detersives and this factor constitutes a powerful argument in favor of the latter. This power manifests itself in two ways, either by the formation of soluble lime salts, or by dispersing lime soaps already formed.

In the first case, there is an increase of detergent power, if the lime salts formed are themselves detersive, for example sulfonated fatty alcohols. In the second case, the action is purely protective, the dispersed lime soaps constituting a harmless ingredient.

The scarcity of fats should have brought into the first rank of importance those products resistant to salts contained in hard water. One could smile, if it were not so tragic, to see the waste that has occurred in the use of our inadequate resources. The manufacture of sulfonated castor oil has been continued instead of making sulfonated ethers of ricinoleic acid, ten times more active, thanks to their stability to lime salts. Likewise, ordinary soaps have been made for use on textiles, in place of sulfonated fatty acid alcohols or sulfonated acids of alkylolamides having much greater activity

and lime resistant.

A wiser plan has come to light in the case of products destined for use in laundry work. These materials are alkaline resinates made resistant to lime salts by addition of sulfonated fatty acid alkylolamides, As Rippert so wisely remarked, at the time of the formation of the Technical Committee on Fats, these would not need to be used in homeopathic doses.

One finds, in the dirt itself, a certain amount of fatty matter sufficient to form, with the sodium carbonate and in the presence of metasilicate, a nascent soap which, according to the researches of Snell, has a much greater activity than the added soaps. Addition of a substance resisting lime salts is necessary to prevent the precipitation of the nascent soap. For this purpose the sodium salts of sulfonated polyalcoylnaphthalenes are very useful as they are wetting- and emulsifying-agents and possess a high degree of resistance to precipitation by lime salts. Their character of foaming does not interfere with the process of laundering. These products have a certain degree of affinity for animal fibers and the result may be judged unfavorably on optical examination. Ringeissen has worked on this matter, recommending a control on spun viscose (staple fiber). It is well to exercise a certain degree of reserve concerning the evaluation of detergents by the gravimetric or the optical method. The materials examined are trade marked products consisting of mixtures of more or less definite compounds. It would seem more logical to have studied the comparative efficiency of different categories of compounds of known chemical constitution.

The mechanism of manifestation of detergent power depends likewise on other variables.

1. The nature of the detergent.—As already indicated, the chemical structure of the detergent influences the elimination of soil. The problem is further complicated by the presence of additional detergents. If one considers soaps and the modern detergents as the essential detergents, though this is not always so, the alkali metal salts and the solvents may be regarded as additional detergents.

These products act principally as solvents, with respect to the fatty matters constituting the soil. The Americans, Vail *(2)* and Snell (*3*) and, above all, those firms interested in the sale of these products, like Philadelphia Quartz, have made very advanced studies of these adjuvants.

In order of efficiency, these alkaline agents have been classified in the following manner:

(1) Agents increasing wetting power; sodium metasilicate and sodium triphosphate, caustic soda, soda ash.

(2) Agents increasing emulsifying power: sodium metasilicate, caustic soda and trisodium phosphate, soda ash.

(3) Agents favoring deflocculation: trisodium phosphate and sodium metasilicate, caustic soda, soda ash.

One notices the lower degree of solvent and deflocculating power possessed by caustic soda and soda ash, which shows that only trisodium phosphate and the silicates permit simultaneous saponification of the fatty impurities and the elimination by dispersion in the lessive of insoluble inorganic and organic particles.

Solvent power does not depend solely on alkalinity; since, at the same alkalinity, all these compounds have the same solvent power. But one has to take into account the nature of the material to be cleansed. It has to be rendered clean, but not altered. Caustic soda, for example, is injurious to rayon and spun viscose, if not used with discretion. In the case of receptacles, for instance, milk cans or tin containers for vegetable oils, which require considerable solvent power, it is necessary to study the behavior of tin and aluminum in the presence of the different detergents.

2. The nature of the surface to be cleansed and the soil to be eliminated.—Detergent power, to which we have given some consideration, depends on the surface to be cleansed. There is therefore a detergent value for each article to be cleansed. It would not be showing the right spirit to consider under a single definition of detergent power, treatments to cleanse textiles, receptacles soiled by their contents, the skin, greasy metal articles, etc.

Very often, with the fibers, one connects the idea of detergent power with the elimination of soil of human origin, that is to say with laundering. The test methods worked out generally relate to this purpose.

There are as many types of detergents as there are fibers to be treated; this is evidence enough.

Therefore the methods of determination of detergent power ought to be regulated in accordance with the materials to be cleansed and the type of soil to be eliminated.

Determination of the Detergent Power of Soap Solutions and Detersives Designed to be Used in Laundry Work

During the last several years, there has been published a great deal of work, both theoretical and experimental, concerning detergent power of soaps and modern detersives. Some methods of determination have been proposed and described, based on washing trials; other procedures, more or less scientific, seek to indicate the detergent power by basing it on measurement of the reduction of surface tension, foaming character, emulsifying power or on its value as a protective colloid.

H. Millier (*4*) employs the stalagmometer to class the different soaps, and indicates a physical procedure for determination of detaching power *(5)*.

The number of drops, foaming power and some other physical properties have been studied by Levinson and Menich *(6)*.

Powney and his collaborators *(7)* have studied the properties of detergent solutions, by measuring the interfacial tension in an atmosphere of carbonic gas by means of the tensimeter of Count du Nouy.

Powney and Forst (*8*) have measured the angle of contact in the system paraffin-air-detergent solution and in the system wool-air-detergent solution, using concentrated solutions of sodium oleate and sodium laurate.

Discussing the penetration of materials by the detergent solutions, under different conditions met with in washing procedures, Powney *(9)* has examined several proposed methods for determination of wetting power and has described a novel electric method for studying the penetration of materials by solutions. He has discovered an important fact. Although the Herbig number of a wetting agent may be practically unaffected by the addition of electrolytes *(10)*, the addition of electrolytes to detergent solutions may considerably affect their wetting properties (see also Commar Robinson, "Wetting and Detergency", p. 144).

King and Mukherjee (*11*) studied the emulsifying power of detergents.

Methods subsequently proposed are entirely empirical. They consist in soiling the articles to be cleansed with various materials and determining the ability of detergents to remove them. In these methods, it is well to note the action of the products being tested at different temperatures, in order to take into consideration the phenomenon of hydrolysis, provoking maximum detersive action.

These methods of evaluation of detergent power, with a few exceptions show the following defects:

1. They are generally laboratory tests in which no account is taken of the conditions under which industrial washing is carried out, either mechanical or manual.

2. The results of the tests very often depend on the personality of the experimenter.

3. The artificial soiling of the articles used to test the detergent only corresponds very vaguely to natural soiling, the types of which are exceedingly variable in quantity and nature.

The method of MacBain *(12)* is based on the quantity of carbon retained in suspension by an aqueous solution of soap. For example, lamp black is emulsified in the soap solution being tested under standard conditions and filtered through regular filter paper. The detergent power is directly proportional to the amount of carbon put into a dispersed state and passing through the filter. This method is not sufficiently precise.

P. H. Fall *(13)* modifies the method of MacBain and Bancroft and determines the quantities of finely divided manganese dioxide that different detergent solutions can maintain in suspension for a definite period of time. Following this method, the author has determined that lowering of surface tension is not a criterion for the estimation of detergency.

Schrewe and Stiepel *(14)* determined by successive weighing of a sample of cloth, the quantity of dirt removed by a washing test under experimental conditions, always the same and easily repeated. The difficulty in this method resides in the fact that it is necessary to measure reductions in weight relatively very minute. Besides, it is necessary to be sure that the cloth always contains the same amount of moisture. This method takes no account of the quantity of soap or other substances which may have been absorbed during washing, all things which can falsify the result. *(15)*.

Thies *(16)* proposed a method which does not eliminate all the difficulties. He measures the quantity of material passed into colloidal solution or, more or less, detached from the fabric during washing.

Hermann *(17)* proposed to determine the minimum quantity of soap necessary to obtain a complete wash. He also suggests using a soiling material *(18)* composed of colloidal indigo paste with mineral oil and benzine.

Berzell *(19)* has made trials with wool cloth soiled with charcoal, grease and ether and measures the quantity of soil extracted, gravimetrically.

Hirose *(20)* suggests a mixture of indigo and lanolin and determines, in addition to the washing test, surface tension, emulsifying power, etc.

K. Brauer *(21)* soils the cloth with spots of various sorts, linseed oil, soot, blood, milk, ink, etc., and examines the treated sample from the point of view of the activity of the various detergents being tested toward these spots.

Various types of soiling have also been proposed by various authors: Fruit juices *(22)*, mixtures of various ingredients, farina, gravy, white of egg, lemon, grilled farina, milk, mustard, grease from fried onions *(23)*, oxide of iron *(24)*, ultramarine *(25)*, mixtures of different oils and carbon; carbon black or lampblack *(26)*.

Carter *(27)* uses a washing machine in which twenty samples may be treated at one time. As soiling agent, he uses a mixture containing oxide of iron, vermilion, etc.

Mikumo *(28)* has made tests to show the equilibrium between the dirty samples and the soap and between the cleaned samples and the emulsion of dirt in the soap.

All these methods have only a limited interest as they do not provide a real standard test and depend on the personal judgment of the experimenter.

A more rational method has been indicated by Shukoff and Schlestakoff *(29)*. This method is somewhat similar to that of Schiewe and Stiepel; however, in place of measuring the diminution in weight of the fabric, one estimates the whitening effect on the washed sample. They use cotton cloth soiled by plunging it into a mixture of lanolin, carbon black and benzine. The difficulty of quantitatively measuring the bleaching effect has not permitted, up to this time, the development of this method.

Rhodes and S. M. Brainerd *(30)* are credited with introducing the system of using the photocolorimeter for making quantitative tests on soiled and treated samples.

They use as a soiling agent a mixture of 2 grams of lamp black, 5 grams of lubricating oil and 2,000 cc. carbon tetrachloride.

The fabric is cut into strips 25 cm long and 10 cm wide; these are passed through the mixture, squeezed and dried at 80° C. They are allowed to stand for 11 hours exposed to the air. The washing apparatus consists of glass compartments, which can be heated by an electric element: It is turned at the rate of about 80 revolutions a minute. Temperature and time can be regulated at will. In testing, the samples are introduced into the apparatus in the form of sacks containing 10 grams of glass beads. After washing, the sacks are removed and plunged into 500 cc. of soap solution of the same strength as used in the washer; they are then washed in distilled water, acetic acid of N/10 strength, and in distilled water again, all at the same temperature as the liquor used in the washing test. The sacks are emptied, pressed between filter paper, dried for one hour at 80° C. The degree of cleansing is determined by means of a photocolorimeter of construction by the authors. This precise method has made it possible to ascertain that the detergent power of soap increases up to a concentration of 0.25%; additions of soap above that point are of no further use.

L. Szego and G. Beretta *(31)* propose the following method:

The washing machine (Fig. 1) consists essentially of a glass cylinder, the dimensions of which are 13.3 cm. in length and 12.7 cm. inside diameter. The cylinder is fitted with brass plates and rubber joints, held by means of springs. The side plates are provided, in the middle, with pipes acting both as rotation axis and for filling up and blowing off the washing and rinsing solutions Inside the cylinder is a sort of drum-shaped basket, coated with rubber.

Cotton cloth, 22 by 22 threads per cm., is first treated for ten minutes with boiling N/10 hydrochloric acid and washed several times with distilled water. Next, it is boiled for five minutes in a N/10 solution of sodium carbonate and again washed with distilled water. A third washing is then conducted with a solution of 0.5 grams soap. After a final washing with water, the sample is dried for one hour in the electric oven at 80° C. The sample is then ironed and its whiteness determined (Bo) using the Pulfrich photocolorimeter making use of filter No. 42, which allows a good reading without eye-fatigue. As delivered by the maker, Zeiss, the instrument is provided with discs of barium sulfate having a whiteness of 100.

The sample, prepared as above, is soiled by immersion in a homogeneous suspension of the following composition:

2 grams vaseline oil.
1.6 grams suet.
0.4 grams linseed oil.
0.04 grams oleic acid.
1 gram fume black, Ultramicronex type (Binney & Smith, N. Y.).
1000 cc. benzine (fraction 75-150°).

500 cc. of this suspension is used to treat a strip 25 by 12 cm. It is allowed to soak in the mixture for some time and then it is dried in the electric oven for exactly one hour.

From this strip of cloth, two sachets are made up measuring ten centimeters square, and the whiteness of these is determined as described previously. Four observations are made on each side of the two sachets and the mean of these figures is taken. Into each sachet is placed 25 grams of glass beads (3-5 mm. diameter). They are introduced into the washing apparatus and washed with 500 cc's of a soap solution containing, generally, 1 gram of soap, or, to be more

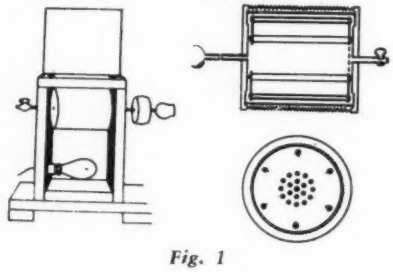

Fig. 1

exact, 0.6 gram of fatty acid as determined by analysis. After washing, the sachets are rinsed in distilled water, dried in the oven at 80° and the whiteness tested on the photocolorimeter.

The duration of the washing period varies, according to the authors, but Rhodes and Brainerd have proved, by tests carried out with ordinary soap, that the quantity of dirt removed from a fabric is not increased by longer washing, but reaches a maximum at about 7-10 minutes. However, Szego and Beretta have demonstrated that two types of soap exist: 1. Those which behave according to the observations of Rhodes and Brainerd (maximum washing 7-10 minutes); 2. Those by which equilibrium is attained in about 4 hours.

The washing is repeated until two successive readings on the photocolorimeter show a constant value. The washing is repeated once again, with a fresh 500 cc. of soap, with the sole object of finding out if there is a still further increase of whiteness. The quantity of dirt per unit of surface n is calculated in the following way: Bo is the original whiteness, ∞ is the coefficient of decrease of this value by combining with the dirt:

$$Bn = \infty\ Bo$$

$$n = \frac{\text{Log } Bn - \text{Log } Bo}{\text{Log } \infty}$$

An analogous method has been proposed by Schwertassek *(32)*, who uses the Pulfrich Photocolorimeter.

Morgan *(33)* has brought forward a somewhat similar method and uses for soiling: 2 grams lampblack; 10 grams Nujol; 3 grams Russian mineral oil; 2000 cc. carbon tetrachloride.

Carties and Sterriker *(34)* have made certain modifications in this method, which has also been studied by Snell *(35)*.

L. Szego *(36)* has investigated the detergent power of sulfonated oils and sulfonated fatty acid alcohols. He has found particularly: 1. That by lengthening the chain of carbon atoms, one increases the detergent power with a maximum for C = 16; 2, that the presence of a double bond in the molecule (alcoyl sulfate) increases the washing power as compared with that of the corresponding saturated compound. The results obtained agree with those obtained by Lottermoser *(37)* by determination of surface tension. They have also been confirmed by the author, by means of experiments on interfacial tension executed according to the method of Harkins *(38)* and by determination of foaming power following the method of Stiepel *(39)*.

The connection between detergent power and the length of the aliphatic chain has already been discovered by several authors: Reumuth *(40)* and Gotte *(41)*. To cetyl sulfate has been attributed, as its principal function, washing power, to lauryl sulfate, wetting; and to stearic compounds, brightening of the fabric.

Rayner *(42)* conceived the following system, which he has applied to the study of soap in the nascent state.

A horizontal copper cylinder, revolvable on its axis, is placed in the solution of detergent to be tested, the level of the liquid reaching to the centre of the cylinder. Attached to the surface of the cylinder, and covering about two-thirds of its surface, is a frame about 1.5 c.m distant from the circumferent surface. The dirty fabric is stretched on this frame and attached by one end to the cylinder itself, forming a kind of pouch. In this way, rotation of the device causes, at one time, rubbing of the fabric against the liquid and passage of the liquid through the fabric.

The soiled cloth is prepared following the instructions of the British Launderers Research Association. Fine calico is desized and the finish removed by treatment with 1% NaOH at 60° C. followed by rinsing and immersion in 1% acetic acid at 60° C. The cloth is rinsed, ironed and cut into pieces measuring 25 by 20 cm., to make it fit the frame of the apparatus. 1 gram of olive oil is dissolved in 100 cc. of benzine and 2.24 grams of Oildag is added. The latter is a fine suspension of graphite in mineral oil, prepared by Acheson Graphite Co. 10 cc. of this solution is used to soil each sample. It is poured on a plate and the tissue laid in it and rolled with a glass cylinder. After two or three passages of the cylinder, the liquor is entirely absorbed. With a little practice it is possible to soil samples uniformly. 6.25 grams of the detergent is dissolved in a liter of water at 50° C. The washing apparatus is rotated at the rate of 120 revolutions a minute. After 20 minutes the temperature of the bath is brought to the boil, this temperature being maintained for 5 minutes. After washing and drying the cloth is examined.

E. Bosshard and H. Sturm *(43)* mention a rapid quantitative method. A piece of wool cloth is artificially soiled by means of oxide of iron. The wool flannel is treated for half an hour at 50° with a solution of ammonium carbonate, then washed, dried and ironed. This is cut into small pieces 10 cm. square. These are impregnated in a beaker containing 200 cc. of distilled water and 20 cc. of a freshly prepared solution of iron-ammonium alum, 8 grams per liter. The beaker is heated on the water-bath for 25 minutes at 90° C. after which the temperature is raised to the boil and the boiling continued until the solution becomes colorless. This takes about 5 minutes. This fixes about 25 mg. Fe_2O_3 on the samples. The washing test is made in a beaker of 2.5 liter capacity, in which is revolved a frame of glass rods to which the samples are attached, without previous drying. The duration of the treatment is 15 minutes at 90° C, at a speed of 100 revolutions a minute, the strength of the solution of the detergent being tested is 1%. They are then washed with distilled water. The samples are dried and calcined and the amount of oxide of iron retained is determined by the Zimmermann-Reinhardt method. The oxide of iron is dissolved in hydrochloric acid and the solution reduced at the boil with stannous chloride, any excess of the latter being precipitated by addition of a little mercuric chloride. After adding a little manganese sulfate solution, phosphoric acid and sulfuric acid, it is titrated with N/50 permanganate. The amount of iron found, deducted from the original iron content of the cloth, gives the amount removed by the detergent; expressed as percentage of the total iron, this gives the value of the product being tested.

To compare the value of similar washing materials, for example different soaps, one relates the detergent value to the fatty acid content. The index of value is the quotient of the washing value and the fatty acid content. It represents the washing value of 1% of the fatty acid of the washing material being tested.

The authors point out that most previous methods of determination of detergent power of a product use, for the spots, a substance containing fatty matter. It would be possible to use such a combination in this method, but the analysis would become more complicated and the results less reliable.

This procedure presents several advantages which reside in the fact that the quantity of oxide of iron deposited is always the same and its composition invariable. It is easy to perform and, carried out by an experienced chemist, it always gives exact results. However, it should be used for evaluating products of the same group. It should be noted, likewise, that the use in the composition of the detersives of chemicals having solvent effect on the iron, particularly such products as Trilon A & B (IG), are liable to affect the results adversely.

P. Cunliffe *(44)* mentions that it is necessary, in determining the efficacy of certain detergents and washing materials to use fabrics on which the artificial soiling may be easily controlled, so that their degree of soil may be constant. It is very difficult to obtain lampblack having uniform particle size; for this reason, the author prefers the use of powdered ilmenite. This is a pigment with titanium base of crystalline form and having the advantage that it can be obtained in homogeneous state. From this point of view, the material which gives the best results

is the pigment air-floated ilmenite (British Titane Products, Billingham). A suspension of this pigment is prepared according to the following recipe:

Gelatin	12 grams
Paraffin oil	30
Lanolin	9
Emulsifying agent	60
Ilmenite	30
Water	3,000 cc.

First the gelatin is swelled in 500 cc. water. Next, the oil and lanolin are mixed together until homogeneous after which the emulsifying agent is added and then the ilmenite. Finally the gelatin solution is added to this mixture and the whole diluted to 3,000 cc. with hot water. This soiling paste is applied to the cloth by means of a padder with two rollers, which must be precisely adjusted to furnish uniform pressure. The impregnated fabric is immediately dried at 50-60° C. If the drying is done at ordinary room temperature, the soiling is not sufficiently permanent and during prolonged storage the soiling agent changes and becomes easier to remove at the time of washing. For this reason the drying is done at 50-60° C. The fabric contians about 3% of lanolin and paraffin oil.

Ewa and Liesegang *(45)* recommend a method of determination of detergent power depending on removal of soot.

G. Gehem *(46)* proposes a washing test which can be used chiefly with lessives. The trials are made on strips of fabric made of a mixture of cotton and cellulose wool of a certain length and width. The strips are prepared with a special mixture of oil and the well known types of soil. Several tests are made; a chemical test, consisting in boiling the strips in the lessive, while agitating the washing machine, a mechanical test, in which the strips are boiled in the lessive and squeezed between two rubber rollers. Finally, it is possible to combine the two systems in a specially constructed apparatus, in which the strips are submitted to the action of the boiling liquor while being continually passed through the squeeze rollers throughout the duration of the test. The degree of whitening of the washed fabric is determined with the aid of the Pulfrich photometer or by means of an apparatus measuring the reflectivity electrophotometrically.

In the application of the material constituting the artificial soil, all the preceding methods suffer from the fact that, in the case of soiling mixtures having a solvent base, it is particularly difficult to obtain a cloth having uniform standard soil. The fabric ought to be dried in the open width and a sufficiently large strip should be cut off the selvages and discarded. It would be preferable to impregnate the fabric while stretched on a frame provided with pins and dry it on the same device while constantly revolving it to prevent the accumulation of soiling substance in creases and on the lower edges of the fabric. The application of the soil by means of a padder, as in the method of Cunliffe, gives a better distribution of the soil. Sisley has obtained interesting results by printing wool flannel with wide stripes of a soiling agent made of 12 grams gelatin, 30 grams discarded used automobile oil, 9 grams boiled linseed oil, 60 grams Emulgol, 90 grams Latexol Black GB conc. (33% dry content) and 3,000 cc. water. The soiled stripes are separated by white spaces. The washing is carried out under standard conditions and the effect of washing is judgd by the whitening of the printed parts and the greying effect on the unprinted spaces. At the same time as the cleansing effect is determined, (removal of dirt), it is possible to select those products showing the least greying effect on the white spaces, indicating a high degree of dispersing power against redeposition of the removed dirt.

The kier method.—This method, used by the Laboratoire Central des Services Chimiques de l'Etat and Stations d'Essais du Bouchet, consists in placing a sample of the soiled fabric under conditions resembling those cloth is subjected to in kier boiling. The quantity of dirt removed is determined gravimetrically.

(a) A Pyrex flask furnished with a reflux condenser is used. The stopper of the flask is fitted with two supplementary openings, for the purpose of introducing the samples into the apparatus. A glass funnel is placed upside down in the flask and this is capped by a thin glass cupel secured in position by pieces of cork or rubber stopper, so that when boiling starts there is a circulation of the liquor such as is observed in the kier. A solution of the washing material is used at 25° Bé. When the temperature reaches 90° C., and the circulation of the liquor begins, the weighed soiled samples are introduced into the apparatus. Duration of the operation is one hour. The samples are rinsed, dried in the oven and weighed.

(b) The formula for the soil is as follows:

Manganese resinate	25
Paraffin oil	75
Toluene	100

The index of cleaning is the amount of dirt removed.

(c) The sample of cloth is a small rectangle 2-3 cm. in width and 8 cm. long. The fabric is raw white rayon. It is well to be sure, by boiling in water for one hour, that the material does not lose more than 2 or 3%.

The manganese resinate is prepared by melting together resin and manganese dioxide.

(d) The soiling is effected by soaking the test samples for 2 minutes in the soiling solution, draining out the excess and drying immediately at 110° C., allowing to hang one and a half hours in the air and weighing.

(e) After being withdrawn from the kier, the samples are washed twice, first with hot distilled water, then with cold distilled water, while rubbing gently with the finger-tips.

(f) The curve of detergency is arrived at by plotting on the abscissa the concentration of the detersive solution and on the ordinate the index of cleansing for each concentration.

Under the described conditions it is well to note that the action of pure water alone removes 30-35% of the soil. When the percentage of soil removed is less than 40%, the differences between one test sample and another, made under exactly identical conditions, exceed 10%. This method does not furnish reliable results in this zone.

When the percentage of soil removed is over 40%, the amount of variation of one sample as against the other is not more than 5%.

The method recently proposed by Ringeissen *(47)* is particularly interesting, since it employs as soiling agent, the exact material which is to be eliminated, that is soil of human origin. The dirt is obtained by separating from the sludge of benzine the residues of dry cleaning.

These sludges contain on the average 58% of fatty matters and their percentage composition is as follows:

Fatty acids	31%
Neutral fats	55%
Unsaponifiables	10%
Colored pigments	4%

A fabric passed through this slime is uniformly colored. It looks as if it had actually been dyed.

In order to define the precise type of color thus obtained, the Toussaint Photocolorimeter is used. In this apparatus, the pure white of a piece of plaster has an average tone of 100, the soiled sample has an average tone of 12.6. The examination of these shades by the aid of the photocolorimeter makes it possible to estimate the degree of washing and whitening obtained with washing materials.

The method is based on an optical measurement made on wool felt. The detergent power is given by the depth of shade obtained as compared with the original soiled sample, by means of the Toussaint photocolorimeter. The trials are made at 70° C., with addition of 2% anhydrous sodium carbonate, which approximates the method employed in practice in the household and in commercial laundries. The determination is quick, exact, and has the advantage that results

can be reproduced by using the exact type of dirt which it is sought to eliminate in laundry processes.

The pressing method.—In order to evaluate the detersive power of soaps, a method has been sought which brings into play mechanical action similar to that of the hand laundress in scrubbing clothes. This method has been decribed by Mlle A. Fleury-Larsonneau and André, in the study of detergent power of soaps containing fillers.

A soil having a base of lampblack is used. After washing, the detersive effect of the product being tested is evaluated colorimetrically.

The test is made with an apparatus of the following description: On a felt covered plank, 65 cm. long by 20 cm. wide, is nailed a framework 5 cm. wide and 2 cm. high which is designed to hold the detergent liquor. This forms a tray 40 by 15 cm. In this tray the scrubbing is done with a wooden tampon 10 by 10 cm. furnished with two slots about 7 cm. apart, arranged to hold in position strips of felt. The function of these is to successively roll and unroll the sample to be tested. The test sample is attached to one of the short sides of the tray and secured by three thumb tacks. The sample is laid lengthwise in the length of the tray. 100 cc. of the detergent liquor to be tested is poured over the test sample cloth and the scrubbing accomplished by the backward and forward motion of the tampon. The operation continues for one minute: the speed of the movement of the tampon is such that, during the minute it makes 50 return trips. The test cloth is rinsed, squeezed out by hand and dried. When the operation is properly performed, it should be possible to see the sample roll and unroll each way from the point of attachment showing each side of the fabric well spread out, after each movement of the tampon.

Regularity of pressure applied is best obtained by always having the same operative carry out this test.

(b) the soiling is accomplished with an emulsion of lanolin and vaseline in an emulsifying medium of water plus oil of turpentine.

Lanolin	50 gram
Vaseline oil	50 gram
Water	125 gram
Turpentine oil	200 gram
Wood charcoal	25 gram

The charcoal used is the type from which black gunpowder is made.

The lanolin is previously dissolved in the vaseline oil on the water bath using a reflux condenser; this mixture is absorbed by the water forming a very thick emulsion which is thinned by successive additions of the oil of turpentine. Finally the black is introduced into the mixture. Some precautions must be observed: overheating of the lanolin vaseline compound must be avoided. Recovered oil of turpentine should not be used; in case of doubt, it should be redistilled before using.

(e) The test sample is a small rectangle of rayon fabric 35 by 75 cm. The soiling is done by painting with a brush first lengthwise then across the width, to give uniform application. The soiled samples are dried for at least three hours in the oven at 120° C. to drive off the higher alcohols from the suintine, the presence of which would cause re-emulsification of the soil.

Detergent Power of Materials Used in Scouring Wool

All the methods previously described relate chiefly to determination of detergent power of materials used in laundering, that is to say, lessives, soaps and more modern detersives having a sulfonated fatty acid alcohol or sulfonated fatty acid amide base. They can be equally well applied to determination of detergent power of products destined for the scouring of wool *(49)*. However, it is not rational to employ a type of soil which has no relation to that which has to be eliminated in reality. The determination of detergent power of materials for use in wool scouring is made by two means:

1. The direct method.
2. The indirect method.

1. Direct method.—The efficacy of products for washing raw wool or grease wool is judged by the appearance of the washed wool, the bath, and the amount of fatty matter which can be extracted with ethyl ether in the Soxhlet extractor.

In numerous laboratories, it is the custom to determine detergent power by making a scouring test on wool in the grease. It is quite evident that this test should be made on a lot of wool which has been rendered more uniform by carding. The wool is conditioned and the amount of fatty matter determined in the Kumagava apparatus by extraction. Next, a weighed amount of wool is treated for half an hour at 40° C. with a solution of the product to be tested at a known strength. The apparatus generally used is that commonly employed for making dyeing trials on leather on the laboratory scale and consists of a wide mouthed bottle having small glass baffles on the interior; the dimensions of the bottle being 30 cm. diameter and 10 cm. deep. The bottle is rotated by means of wooden friction rollers within an oven furnished with a thermostat. The wad of wool is rinsed in tepid water for a quarter of an hour, then in distilled water for a quarter of an hour at 40° C., conditioned and weighed again. From these figures the percentage of fatty matter removed is calculated, this gives an indication of the degreasing power of the agent being tested. This method allows the comparison of two samples, but does not constitute a standard method. The amount of grease in wool can be determined by a rapid extraction method. 5 grams of the wool are weighed out and placed in a small copper cylinder furnished with a piston, worked by hand. 20 cc. trichlorethylene are added and the wool is squeezed for a certain determined time. The volume (of liquid) is measured, the wool is dried and weighed on a special balance which gives directly the percentage of grease and wool. This device, called a Greasometer, is manufactured by the American Chemical Paints of Ambler; it gives sufficiently accurate results for industrial testing, rapidly.

2. Indirect method.—Strips of wool cloth of uniform length are impregnated with a soiling agent consisting of olive oil tinted with an oil-soluble coloring matter, for example Sudan Violet BR. The washing is conducted in a special type of washing machine, using the degreasing agent, at known concentration, with addition of 1 gram per liter of calcined sodium carbonate. The time of treatment is 5 minutes. Conditions of temperature and relation of volume of bath to weight of wool being standard, likewise the method of rinsing. After drying, the degree of degreasing is determined, by means of the Toussaint photocolorimeter, by comparing the difference of intensity of color between the washed and unwashed samples.

This method finds application principally in the evaluation of detergent power of materials used for scouring of goods to eliminate added wool oils. For estimating the detergent power of materials used in the degreasing of raw wool, wool grease extracted from raw wool by means of a volatile solvent is used in place of olive oil.

The materials most generally employed for scouring and degreasing wool are soaps with addition of sodium carbonate or trisodium phosphate and the sulfonated fatty acid alcohols, especially the sulfonated alcohols of oleic acid. The action of these materials is reinforced by addition of solvents.

Detergent Power in Cleansing Hair and Shampooing

In the treatment of living hair the problem is not the same. While foaming power appears to be essential to the user, the factors of prime importance are emulsifying power and detergency. Solvent action should be moderate. The dirt should be eliminated without removing the natural oils which give suppleness to

the hair. If a laundry lessive be used, instead of a well compounded shampoo, the hair is stripped of these oils and becomes hard and brittle. Materials too strong in wetting power and totally removing all grease put the skin of the scalp into a sensitive state toward attack by various deleterious agents, some hair dyes for instance.

The fatty acid alcohol sulfonates, particularly those in the range C_8 to C_{12} (lauryl alcohol) of a fatty character, and having a direct affinity for hair, are to be recommended for this purpose. The employment of cation active bodies like diethyl-cetyl-ammonium hydrochloride in combination with partly sulfonated fatty acid alcohols, reacts by reason of its negative character, to fix the anion-active body on the hair giving it suppleness.

The problem is different when it comes to the handling of dead hair, pig bristles or furs, where wetting power is, contrary to the foregoing, important in dyeing. For this work it is customary to use sulfonated alcoyl-naphthalenes and sulfonated fatty acid alcohols, especially lauryl alcohol.

Detergent Power in the Treatment of Silk

It would not be quite correct to consider detergent power as the essential factor in degumming silk although the elimination of dirt involves the use of boiling soap. Solvent action arrived at by the pH value linked with the hydrolysis of the soap and the colloidal nature of the medium play an important role in silk degumming. The value of a product for degumming is determined by estimating the amount of fibroin removed by a given quantity of soap. Almost invariably soap made from olive oil foots is used for this operation, sometimes with addition of hydrocarbon solvents of high boiling point.

Detergent Power in the Boiling Off of Vegetable Fibers

The testing of auxiliary products such as detergents, that is to say, the determination of foaming, detergent and emulsifying power, do not give sufficient indication of their value, as additions, in the boiling off of cotton, considering the constitution of the impurities occurring in this fiber (pectic matter and waxes).

The examination of the activity of auxiliary materials used in boiling off cotton can be made in two ways.

In the case of open tub boil off, it is sufficient to make the test in laboratory dye pots, using increasing concentrations of the sample being examined, against a fixed quantity of a typical product, without adjuvants.

The trials are made on 10 gram skeins of raw cotton for one hour at the boil with addition of sodium carbonate. The skeins are rinsed, dried, and their wetting time determined in distilled water at 20° C. From these figures, one can compare the activity of the products examined against a known type. It is also advisable to make another wetting test, following the method of Erben, using the spent liquor from the boil off bath. This gives an idea as to the stability of the product to this liquor. The trial is repeated with water of known hardness, for example, with water showing 40° hardness; these figures give an indication as to the resistance of the material to the effect of hard water.

If more precise figures are desired, the amount of wax eliminated from the fiber by a known quantity of the adjuvant may be determined by extraction.

In the case of kier boiling, the estimation can be made following this method which is attributed to Dhingra, Uppal and Venkataram *(50)*.

A small soft steel kier (fig. 2) furnished with a double bottom (manufactured by Edminston & Sons, Patricroft), is used. The kier has a diameter of 10 cm. and is 50 cm. deep, its capacity being 10 liters. It operates at a pressure of 2 atmospheres. Circulation of the liquor is effected by a centrifugal pump. The liquor is drawn from the bottom of the kier and pumped through an external cylinder which is directly heated by gas. From this chamber, the liquor returns to the top of the kier and passes through the cloth.

A piece of raw cotton twill is desized for one hour at 40° C. with a solution of Diasta for containing 1 per cent salt, and allowed to lie overnight, passed through the washer, and dried on the cans. In the test 1 kilo of goods is used, 18 grams of wetting agent and eight liters of water, which represents a goods to liquor ratio of 1:8. The treatment continues for 5 hours at 2 atmospheres pressure. The cloth is afterwards washed several times, squeezed and dried.

The wax content is determined in the Soxhlet extractor, treating for 24 hours with trichlor-ethylene. The quantity of wax is calculated on the dried and conditioned cloth.

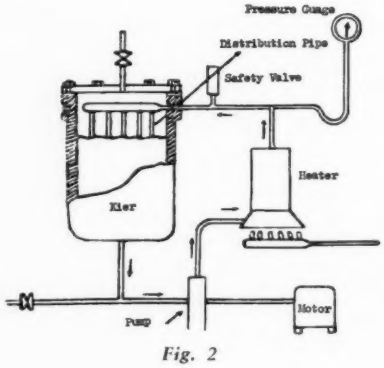

Fig. 2

It should be noted that trichlor-ethylene has a tendering action on cotton; but, by making a blank test on a sample of bleached cotton calico, it can be proved that no soluble substance is thus produced in the trichlor-ethylene.

After the boil off test, a wetting test is made on the material boiled off. This test may be completed by a bleaching trial, followed by a determination of the wettability and a measure of the whiteness by means of the photocolorimeter.

This test, although a little complicated, gives results which approximate closely the results obtained on the practical scale.

In the boil off of cotton, wetting agents are chiefly used, particularly sulfonated esters of castor oil and sulfonated fatty acid alcohols with or without additional solvents.

Detergent Power in the Treatment of Rayons and Spun Rayon

To conclude with the textile fibers, in the preparation of artificial fibers before dyeing, the objective sought is the elimination of the sizing. Those having a base of linseed oil require the use of a saponifying agent, those having a wax base need treatment with materials having emulsifying and solvent properties. The testing of adjuvants for use in desizing is carried out by treating sized skeins in baths containing increasing amounts of the agent to be examined. The degree of desizing of the treated skeins is determined by dyeing them in a solution of a dyestuff soluble in organic solvent, which will dye the size.

In the case of viscose sized with linseed oil, caustic soda is used, in other cases, wetting agents like the sulfonated fatty acid alcohols.

Nature of the Water Used

As has been previously pointed out, the various modern detersives are differentiated from soap by the following characteristics:

(1) Modern detergents are not hydrolizable and, due to this fact, are neutral in aqueous solution, which makes it possible to carry out the washing in a neutral medium, thus permitting treatment of delicate textiles.

(2) Modern detergents made from sulfonated fatty acid alcohols, sulfonated fatty acid alkylolamides and products of condensation of fatty acid chlorides with sulfonated acids of oxy- and methylaminoethane and with degraded albumens, the oxy-ethyl derivatives of fatty acids, possess the advantage over soap that they form calcium and magnesium salts soluble in water, which obviates the loss of material by formation of insoluble metallic soaps by the precipitating action of the salts constituting the hardness in water.

(3) Modern detergents have, in most cases, a much greater yield than soap.

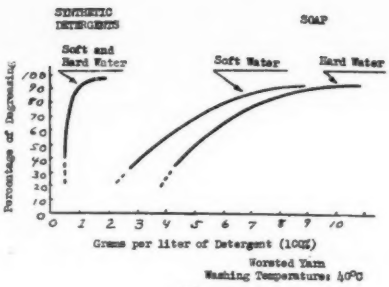

Fig. 3

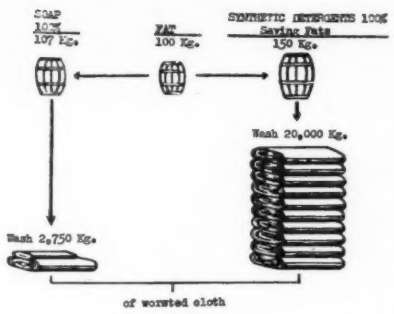

Fig. 4

From the same amount of fatty acid it is possible to make washing materials whose effect is considerably greater than that of soap.

G. Schwen (*51*) has compared the degreasing action of the modern detersives with that of soap in the washing of woolen articles in soft and hard water. In Fig. 3 is shown the rapid rise in the curve of degreasing with the synthetic products, while the curve of soap approaches the horizontal, indicating the necessity of employing stronger concentrations in order to obtain the same degree of degreasing. The modern detergents, thanks to their stability toward the salts constituting hardness in water, show the same curve with both soft and hard water, whereas soap requires distinctly larger quantities in the case of hard water.

G. Schwen indicates graphically (fig. 4) that, with the same amount of fatty acid in the form of the modern detergents, it is possible to wash much larger quantities of woolen piece goods than in the form of soap.

Taking these facts into consideration, it is easy to see that the nature of the water used has considerable influence on the various operations of washing and rinsing and that determination of the degree of hardness of the water is indispensable.

The installation of purifiers and water softeners is to be recommended to treat water for these operations. The employment of modern detersives is advantageous where soft natural water is unavailable or there is no system of water softening.

These two last-named factors have considerable importance from the standpoint of economy of fats. It is known, for example, that 1000 liters of water of 27° hardness destroy 2.25 kg. of Marseilles soap (70 per cent).

Conclusions

The above review makes no contribution to the definition of detergent power. Nevertheless it recounts the combination of factors on which detergency depends and establishes clearly that detergent power is one word which should at least be put in the plural.

In order to be complete this statement, in addition, should serve to point out that the enormous profusion of materials, put on the market under the utmost diversity of names, has created a problem regarding the making of a judicious choice for any particular application.

It is not astonishing, therefore, that modern detergents have been discredited to a certain extent. There are more than four thousand brands, some houses have offered more than two hundred different compounds. The users have been tired of examining such a profusion of samples, of which the sellers themselves did not know the correct use.

It is necessary to acknowledge the interest of Capron, Dieserens, Heltzer, Sisley and Vallé in classification.

More recently, a classification of the products of the manufacturers engaged in treatment of oils, (sulfonating, condensation, etc.), including oils of vegetable, animal and mineral origin and fatty acid alcohol derivatives has been elaborated by Koechlin, Sauzay and Sisley. This classification has a double objective: to make it possible to determine by simple indications of nomenclature at the same time the physical properties and chemical constitution of a material and its method of use and its field of application. It is hoped to establish a general classification and that a uniform system of naming these products may be arrived at.

However, such a classification will only take on its full value by the establishing of official standard tests for the determination of value in industrial application.

In reality, in the case of the estimation of detergent power of washing materials, two types of methods come to the fore; gravimetric methods and optical methods. The method employed at the Laboratoire Central des Services Chimiques de l'Etat et Station du Bouchet, depending on the Direction des Industries Chimique for the examination of detersive products, elaborated by Mlle. A. Fleury-Larsonniere and M. André (*52*) is based on a gravimetric estimation.

These gravimetric methods have been vigorously criticized by Ringeissen (*53*), who has evolved a method of determination of detergent power which is particularly ingenious, based on optical measurement.

The present study does not pretend to judge the value of the different methods proposed, but limits itself to posing the problem, while hoping for the institution of rational official standard methods of testing detergent power in relation to the diverse operations of washing, scouring, cleaning and laundering the various textile fibers.

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44. J. Text Ind., V. Tiba, aout 1938, No. 8, p. 463.
45. Fette-u. Seifen, 1940, *47*, No. 10, 458-460.
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47. Published in the review, Teintex of February 15, 1943, p. 32.
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50. J. Soc. Dyers Col., 1937, p. 98.
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• PATENT DIGEST •

PAUL WENGRAF

Waterproofing Textiles — Latex — Resin compositions G, 2, 02

Brit. P. 580,134
(International Latex processes, Aug. 28, 1946; application, May 18, 1944)

The deposit of rubber and water insoluble resins on fabrics has often been described. The specification mentions U. S. Pat. 2,173,241 and U. S. Pat. 2,173,-243 as well as Brit. P. 508,136-7 and others. It has been found that there is a tendency of these layers to become tacky so that it might be difficult to pull the material, especially stockings, on and off the drying device. The process can be improved however by first coagulating the latex particles with one of the usual anion active auxiliaries (for example Aquarex D-monosodium sulfate ester of half lauryl and one-half myristyl alcohol) and treating the fabrics thereafter with a cation-active reagent. Examples for the cation active agents are particularly Sapamine A = acetate, MS = methosulfate and CH = chlorohydrate of asymmetrical substituted diamines; high substituted glyoxalidines can also be applied as aftertreating compounds. This treatment has the purpose to convert the electronegative charge of the rubber particles into an electropositive one. A precipitating action, analogous to that occurring in the so-called substantive delustering process, has to be assumed: in this delustering method the particles of a pigment are fixed by alternatively conferring a negative charge and thereupon a positive charge to rayon fabrics.

References: Brit. Pat. 411,478 (Imp. Chem. Ind.) suggests to use higher alkylsulfates (cetylsulfate), thus anion active agents for stabilizing latex dispersions. Brit. P. 463,934 (U. S. Rubber) recommends stabilizing rubber dispersions with amines (hydroxylamine); U. S. Pat. 2,002,622 (du Pont) protects stabilizing latex dispersions with rosin sulfonates such as sulfonated abietane or abietene.

Discharges on insoluble azo-dyestuffs — Sulfo-Stilbene derivatives used D, 2, 02

Brit. P. 580,205
(Imp. Chem. Ind., Hardacre, White, Aug. 30, 1946; application, June 18, 1945)
Brit. P. 581,090
(Imp. Chem. Ind., Hardacre, White, Oct. 1, 1946; application, July 27, 1945)

According to the present invention discharges on dyeing, consisting of insoluble azo dyestuffs, are often poor because of an insufficient destruction of the dyestuff. A substantial improvement in the purity and brilliance of the white pattern is effected by adding small portions of *sulfo-stilbene derivatives* to the discharge paste. One of the examples relates to a sulfoxylate discharge on a brown azo dye from tetrazotized benzidine. The sodium salt of 4:4'-bis (p-amino benzoylamino) stilbene 2:2' - disulfonic acid is added in relatively small amounts. According to the second patent the same products can be used for *preparing resists* under oxidation dyetuffs like aniline black, Paramine brown (p-phenylene diamine brown). The resist pastes are composed in this case, besides the stilbene derivative of the usual ingredients, of sodium acetate, sulfite and the like.

Reference: The stilbene derivatives, unknown up to now in the property of increasing the discharge effect of reducing agents seems to act like anthraquinone, Induline Scarlet or other auxiliaries, used in the discharge technique. It is known that stilbene derivatives form with formaldehyde insoluble resins (French Pat. 905,534, Geigy) and that these condensates have a bleaching action too.

Resins, Modified, as finishing agents G, 2, 01

Brit. P. 581,127
(Distillers Company Ltd., Morgan, Frenkel, Oct. 2, 1946; application, Jan. 21, 1942 and 1943)

It is known to use phenol aldehyde condensates for preparing water soluble resin precondensates which may be applied in various textile finishing processes such as creaseproofing, shrinkproofing operations and in producing permanent finishes. The amounts of the components have to be carefully checked because an excess of sodium hydroxide (used as a catalyst) has the effect of speeding up the condensation in an undesired degree so that this solution becomes very soon cloudy or gel-like. Attempts have been made of adding an acid at the right moment to one of these pre-condensates ("Novolak") in order to stop this reaction. The present invention claims to have found a simpler way by condensing first, for instance, 100 p. cresol with 100 p. formaldehyde solution (concentration non disclosed) in the presence of 1 p. sodium hydroxide as a catalyst. After reacting the mixture for 10 minutes 7 p. of oleic acid are stirred in at 70° C. Thus the mixture consists of soap, alkali, phenol formaldehyde. A better stability and dispersion are attained.

References regarding stabilizing of resin condensates: U. S. Pat. 2,400,718 (Reichold Chemicals): stabilizing of "Novolaks" by neutralization, adding thereupon an excess of formaldehyde. U. S. Pat. 2,331,-744 (Am. Cyanamid): phenol formaldehyde condensates are preserved from discoloration by using melamine stabilized formaldehyde.

Creaseproofing Textiles — Boro-organic Compounds as catalysts G, 2, 04

U. S. Pat. 2,416,151
(Courtaulds Ltd., Boulton, February 18, 1947; application, November 26, 1943, Brit. Prior, December 21, 1942)

Different methods for rendering fabrics creaseproof have been recommended since the first invention, made in this field by the Tootal-Broadhurst-Lee Company (Brit. P. 291,473-74). These processes are mostly based on the application of water soluble pre-condensates of the thermosetting type, for instance urea-formaldehyde, or melamine-aldehyde condensates and the like. A drawback was found in these condensates which undergo premature condensation after adding the acid catalyst. The present specification discloses the fact that boric acid, added to the known tartaric or lactic acid catalysts improves the stability of the finishing solution. It is assumed that borotartaric or borolactic acid are formed when the single components are mixed with a urea-formaldehyde precondensate, the latter being prepared under alkaline conditions (pH = 9). The impregnated fabrics are dried at 60-90° C. and heated thereupon at 135-140° C. It is claimed that the tensile strength of the fibers is less impaired in using this method.

References cited by the U. S. Patent Office are amongst others:

U. S. Pat. 2,093,651 (Widmer, Pierce): animalizing cotton with urea-formaldehyde in order to increase the affinity to acid dyestuffs.

U. S. Uat. 2,219,375 (Rohm & Haas): non condensed solutions of urea and formaldehyde as finishing agents. An ammonium salt is added as an acid splitting substance.

Other references: It is interesting to note that boron compounds themselves have creaseproofing qualities without

combining them with resin condensates. U. S. Pat. 2,091,567-68 (Poutaux Martin Co.) claims that boric acid and salicylic acid themselves, in ammoniacal solution, give a creaseprofing finish which still can be improved by adding formaldehyde or hexamethylene-tetramine. A composition of borax, sodium silicate and zinc acetate has also proved to give a creasproofing effect. (Brit. 457,659, Pomphrey). The creaseprofing component is here zinc borosilicate: $Zn_6 (BO_3)_2 (SiO_3)_3$.

Jute-Fibers—Improving the quality of yarns by binding loose fibers A, 7, 04

U. S. Pat. 2,416,272
(Amer. Viscose Corp., Wallach, February 18, 1947, application, April 23, 1942; Brit. Prior, June 29, 1938)

Jute threads have often loosely attached fibers. These loose single hairs give the fabrics not only an unpleasant appearance but they have also some other drawbacks, for instance that of shedding into the contents of a bag or the like, manufactured from jute. This problem has been solved in former times by depositing cellulose xanthate and precipitating this substance later on to make the loose fibers adhere to the yarn surface. Another method has been tried in form of an impregnation with a rubber solution. In this case the coagulated rubber layer can only difficultly be removed later on by an organic solvent treatment. For this reason dyeing or bleaching of the thus treated fabrics becomes almost impossible. According to the present patent a fiber binding action is exerted by solutions of cellulose having a pH below 8 because stronger alkaline liquids deteriorate the fibers. Examples are for instance: a water soluble ethyl cellulose in a 5% solution (pH = 7), a 5% solution of alpha cellulose in zinc chloride (pH = 1.5) a 5% solution of purified cotton in hydrobromic acid and so on.

References, cited by the U. S. Patent Office are amongst others:

U. S. Pat. 2,087,237 (du Pont): cellulose glycollic acid size;

U. S. Pat. 2,145,303 (Hentrich et al.): glycol chlorohydrins used as thickeners;

U. S. Pat. 2,342,785 (Rohm & Haas): improving the wear resistance of textile with different substances such as starch or ethoxycellulose.

Other Reference: Alkyl celluloses have been recommended as sizing agents for different fibers according to U. S. Pat. 1,978,785 (Celanese).

Laminated Fabrics—Thermosetting and thermoplastic resins used G, 2, 01

French P. 914,413
(Hart Productions, Ltd., Oct. 8, 1946; Brit. Prior, September 4, 1944)
French P. 914,490
(Hart Productions, Ltd., Oct. 9, 1946; Brit. Prior, April 9, 1942)
(acc. "Teintex" Febr. 15, 1947, p. 61)

The first patent relates to laminated fabrics by using as an intermediate layer pre-condensates combined from thermoplastic and thermosetting resins. An example for the first resin type is a polvinyl acetal resin, for the thermosetting part a urea-formaldehyde condensate. In an example a cotton tissue is treated with a solution of formaldehyde, urea, sodium acetate, polyvinyl alcohol (dissolved in methanol), acetone, amyl tartrate and cresyl triphosphate. The impregnated fabric is dried at low temperatures (30° C) and fixed by sewing between two sheets of cellulose acetate, finally subjected to a pressure treatment at 150° C. The second patent discloses the innovation of mixing a silica gel to a thermoplastic resin, fusing at about 100° C, anyhow at a temperature below that at which the outside layers could be damaged. The principal idea of these patents is that the thermoplastic resin is melted in the laminated process and the thermo setting components imbedded in this mass are hardened and fixed solidly at the same time and adhere to the compounded sheets on both sides of the inner layer.

References: U. S. Pat. 2,392,621 (Pittsburgh Plate Glass Co.); glycols heated with diethylfumarate or a similar ester in the presence of a catalyst (p-toluene sulfonic acid) are used for laminating cloth. U. S. Pat. 2,380,775 (W. Meyer) proposes to laminate fabrics by incorporating fresh precipitated silicic acid as absorbent for thermoplastic resins. The U. S. Pat. 2,107,485 (Trubenizing Process) protects quite generally the application of thermoplastic resins and the Brit. P. 581,651/1946 (Imp. Chem. Ind.) laminating with polyvinyl compounds. For other references see Abstracts to U. S. Pat. 2,409,703-04 (Celanese—Oct. 22nd, 1946) in Group G, 2, o1, page 288, June 2nd issue, AMERICAN DYESTUFF REPORTER.

Fire and Rot Resistant Finish—Vinyl Polymers G, 2, 03

U. S. Pat. 2,418,843
(Leatherman, April 15, 1947; original application, June 20, 1942, divided, and this application June 30, 1945)

This patent is a division of the copending patent U. S. Pat. 2,407,668 issued on September 17, 1946 (see AMERICAN DYESTUFF REPORTER p. 154 (1947). This invention may be used for and by the Government of the U. S. without paying any royalties (act of March 3, 1883). The process patented here can be carried out in different ways. A water repellent but porous finish can be produced by dipping it in the coating solution and squeezing it lightly, whereby tiny holes are formed, permitting free passage of air *but not of water.* The coating liquid can thereupon be applied on both or only on one side. In the second event the fabric retains its soft appearance. The coating ingredients are (1) a vinyl polymer, for instance polyvinylchloride; (2) zinc carbonate, liberating carbon dioxide when the vinyl polymer decomposes in igniting. The hydrochloric acid fumes developed act as well as fire extinguishers as the CO_2; zinc oxide remains which acts as a dehydrating catalyst; (3) a pigment for screening out light which might prematurely decompose the polyvinylchloride; (4) a plasticizer and (5) a rotproofing agent, for instance pentachlorophenol.

References: Polyvinyl chloride mixed with chlorinated naphthalene was first described as a flameproofing agent in French P. 766,369 (I. G. Farbenind). For further references see abstract in AMERICAN DYESTUFF REPORTER, 1947, p. 154, relating to the author's U. S. Pat. 2,407,668.

INDEX TO PATENT DIGEST

FOLLOWING is an index, by subject and patent number, of the patent abstracts that have appeared in these pages from July, 1946, through June, 1947. The number in parentheses, following the page number, refers to the year in which the abstract appeared.

SUBJECT INDEX

ACID Dyes—Improvement of Washfastness (Ger. P. 748,450)..459 (1946)
ACID DYES—Phosphoric acid added (Austral. P. 121,131)....311 (1947)
ACRYL POLYMER FIBERS—Dyeing (Brit. P. 576,793).....504 (1946)
ACRYL—or VINYL POLYMERISATES as finishing agents (U. S. P. 2,406,453 and U. S. P. 2,406,454)..... 99 (1947)
ADHESIVES—Resinous products, Acylthioureas as catalysts (Swiss P. 238,151).....311 (1947)
ANIMALIZING CELLULOSE—Dyed with acid dyestuffs (U. S. P. 2,391,942) 336 (1946)
ANIMALIZING—Cellulose Yarn (Aus. P. 159,297).....378 (1946)
ANIMALIZING CELLULOSE YARNS—Cyanamide Resins (Ger. P. 749,051) 459 (1946)
ANIMALIZING—Preparing with Guanidine Salts (U. S. P. 2,417,312) 367 (1947)
BLEACHING—Alkali stannates added (U. S. P. 2,417,570).....367 (1947)
BLEACHING—Chlorine, Peroxide combined (Aus. P. 158,996)....377 (1946)

July, 1946 through June, 1947

BLEACHING CHLORITE—Persulfate added (Brit. P. 576,909-910) 100 (1947)
BLEACHING—Peroxide (U. S. P. 2,391,710) 335 (1946)
BLEACHING—Spun Rayon (Ger. P. 749,804) 460 (1946)
BOILER WATER—Treatment (U. S. P. 2,400,543) 458 (1946)
CALENDER ROLLS—Vinyl polymerisates (Swiss P. 238,525) ..311 (1947)
CASEIN—Fibers (Brit. P. 573,432) 377 (1946)
CELLULOSE ACETATE PRINTING—Acid dyestuffs (Brit. P. 579,718) 281 (1947)
CELLULOSE ACETATE FABRICS—Pre-treatment (U. S. P. 2,399,627) 440 (1946)
CELLULOSE ACETATE PRINTING—Discharges (U. S. P. 2,409,980) 283 (1947)
CELLULOSE ETHER plus RESINS—Coating (Brit. P. 572,906) .475 (1946)
CELLULOSE GLYCOLLIC ACID (Brit. P. 572,868) 337 (1946)
CELLULOSE GLYCOLATES—for Lubricating Wool (Ger. P. 748,632) 459 (1946)
CELLULOSE SOLUTIONS—Warp sizing (U. S. P. 2,402,652) ..719 (1946)
CELLULOSE SOLUTION—Water res. finish (U. S. P.2,397,437) .378 (1946)
CELLULOSE SOLUTION ZINCATE—for permanent finishes (Ger. P. 749,082) 460 (1946)
CELLULOSE ZINCATE SOLUTIONS—Transparentizing (Brit. P. 581,436) 367 (1947)
CHLORITE SOLUTIONS—Preparing (Brit. P. 577,054) 249 (1947)
CLAMP FOR DRYING CLOTH (U. S. P. 2,400,766) 476 (1946)
COLD SOAP—for finishing purposes (Brit. P. 575,949) 503 (1946)
CREASEPROOFING TEXTILES—Heavy metal salts added to Resin condensates (Ger. P. 749,928) 311 (1947)
CREASEPROOFING TEXTILES—Thiocyanates and Metaphosphates (Brit. P. 579,709) 288 (1947)
CREASEPROOFING TEXTILES—Thiocyanate as curing catalyst (U. S. P. 2,411,818) 248 (1947)
CREASE RESISTANT FINISHES—Polysulfones as curing agents (U. S. P. 2,410,395) 281 (1947)
CREPE—Effect on Nylon (Brit. P. 576,050) 503 (1946)
CURLED EDGES—Removing (U. S. P. 2,402,621) 817 (1946)
DEFOAMING—Different Solutions (U. S. P. 2,408,527) 155 (1947)
DEFOAMING—Washing Solutions (U. S. P. 2,407,589) 154 (1947)
DELUSTERING—Dry Spun Viscose (Swiss P. 240,201) 457 (1946)
DELUSTERING—Nylon (Brit. P. 574,785) 399 (1946)
DELUSTERING — Urea-Formaldehyde Condensates (U. S. P. 2,416,988) 366 (1947)
DIRECT DYES—Fastness Increasing (Brit. P. 576,562) 503 (1946)
DIRECT DYES—Improving Fastness by substituted adipamides (U. S. P. 2,416,884) 338 (1947)
DIRECT DYES—Improving Light Fastness (French P. 865,-903) 717 (1946)
DRYING FABRICS—Apparatus (Brit. P. 572,113) 337 (1946)
DRYING FABRICS—Apparatus (U. S. P. 403,630) 38 (1947)
DRYING FABRICS—Apparatus (Can. P. 438,681) 336 (1947)
DYEING AND WASHING DEVICE—Tension reduced (Brit. P. 579,258) 280 (1947)
DYEING APPARATUS (U. S. P. 2,405,665) 37 (1947)
DYEING CELLULOSE ACETATE—Vat Dyestuffs (Brit. P. 578,212) 99-100 (1947)
DYEING CELLULOSE ACETATE—Diazotized Dyestuffs (U. S. P. 2,403,900) 16 (1947)
DYEING—Reduced Pressure (French P. 865,783) 717 (1946)
EMBOSSING—Fabrics (Brit. P. 573,250) 376 (1946)
ENGRAVING COPPER ROLLERS (Ger. P. 749,151) 460 (1946)
FELTING PROPERTIES—Increased (U. S. P. 2,411,725) 248 (1947)
FELTING PROPERTIES—Reduced (U. S. P. 2,401,479) 457 (1946)
FELTS—Water Resistant (Brit. P. 575,264) 475 (1946)
FLAMEPROOFING—Waterproofing Coatings ((Brit. P. 575,028 .474 (1946)
FLAMEPROOFING—Antimony Compounds (Brit. P. 579,328) .280 (1947)
FLAMEPROOFING—Arsenic Compounds (Brit. P. 573,471) 377 (1946)
FLAMEPROOF COATING—Polyvinyl-Methacrylate Derivatives (U. S. P. 2,407,668) 154 (1947)
FLAMEPROOFING—Organic Silicates (Brit. P. 574,548) 377 (1946)
FLAMEPROOFING—Terpene Treatment (U. S. P. 2,407,988-9) .156 (1947)
FLAMEPROOFING TEXTILES—Urea plus Ammonium Salts (Brit. P. 575,903) 476 (1946)
FLAMEPROOFING—Zinc Soaps used (U. S. P. 2,406,779) 153 (1947)
FORMALDEHYDE—Treatment of Rayon (Brit. P. 575,964) 503 (1946)
FLOCK—Printing (Brit. P. 573,855) 376 (1946)
FLOCK PRINTING—Fibrous Cellulose Powders (French P. 864,099 and 864,100) 457 (1946)
FUMEPROOFING—Acetate Dyes (U. S. P. 2,403,019) 17 (1947)
FUMEPROOFING ACETATE DYES—With Hydroxy Monamines (U. S. P. 2,409,257) 248 (1947)
GAS RESISTANT—Textiles (Brit. P. 575,379) 476 (1946)
GLASS FIBERS—Coloring (U. S. P. 2,394,493) 336 (1946)
HAIR KERATIN SOLUTIONS—for Finishes (U. S. P. 2,413,983) 337 (1947)
LAMINATED FABRICS—Citric Esters as plasticizers (U. S. P. 2,409,703-4) 288 (1947)
LAUNDERED ARTICLES—Aftertreatment (U. S. P. 2,407,635) .155 (1947)
LOCUST BEAN GUM THICKENERS—Alkali resistant (Ger. P. 749,708) 460 (1946)
LUBRICANTS FOR WOOL—Amine Salts (Ger. P. 748,836) ...459 (1946)
LUBRICANTS FOR WOOL—Chlorinated Paraffins (Brit. P. 574,828) 474 (1946)
LUBRICATING ACETATE—Staple Fibers (U. S. P. 2,406,407 and 2,406,408) 99 (1947)
LUBRICATING RAYON—Mineral Oil Dispersions (U. S. P. 2,401,240) 458 (1946)
LUBRICATING RAYON—Mixed Ether-Esters (575,531) 476 (1946)
LUBRICATING TEXTILES—Alkylphosphoric Acid Derivatives (U. S. P. 2,413,428) 366 (1947)
LUBRICATING WOOL—Apparatus (U. S. P. 2,405,857) 38 (1947)
MERCERIZING—Sulfite Waste Liquor, (Austrian P. 159,421) ..378 (1946)
METALLIZATION — of non-conductive materials (Brit. P. 575,148) 475 (1946)
MILDEWPROOFING CLOTH—Diphenyl Derivatives (U. S. P. 2,403,945) 17 (1947)
MILDEWPROOFING TEXTILES (U. S. P. 2,401,028) 440 (1946)
MILLING CLOTH—Cell Wool, Blended Wool (Dan. P. 64,897 and 64,932) 249 (1947)
MILLING MIXED FABRICS ACETATE CELLULOSE—Wool (U. S. P. 2,407,602) 154 (1947)
MILLING—Wool plus Acetate Staple Fibers 475 (1946)
MIXED WOOL COTTON FABRICS—Peptides as protecting agents (Ger. P. 749,387) 460 (1946)
MIXED WOOL-RAYON—Finishing (U. S. P. 2,399,559) 439 (1946)
MOISTUREPROOF COATING—Aroclor (Brit. P. 577,256) 249 (1947)
NYLON—Delustering (Brit. P. 574,785) 399 (1946)
NYLON—Increasing Light Resistance (Brit. P. 572,136 ..... 337 (1946)
NYLON — Sizing with Dioxolane — Condensates (U. S. P. 2,406,749) 153 (1947)
OAT PREPARATIONS FOR—Printing Thickeners (Brit. P. 578,802) 280 (1947)
OPENING WEBS—in Rope Form—for Bleaching and Dyeing (U. S. P. 2,411,414) 218 (1947)
PECTIN—and other hydrophilic powders—preparing (U. S. P. 2,412,282) 337 (1947)
PECTINS—as Detergents (Ger. P. 748,449) 458 (1946)
PERMANENT—Coating (Brit. P. 573,574) 376 (1946)
PERMANENT—Finishes (Polymers) (Brit. P. 573,834) 377 (1946)
PERMANENT FINISHES—Stilbenic Acid Derivatives (French P. 905,534) 154 (1947)
PHOSPHONAMIDES of CELLULOSE—Flameproofing (U. S. P. 2,401,440) 440 (1946)
PIGMENT DYEING and PRINTING (Brit. P. 574,814) 474 (1946)
PIGMENT—Printing (Brit. P. 573,558) 376 (1946)
PIGMENT PRINTING—Gelled Resin Solutions ((U. S. P. 2,416,620) 366 (1947)
PIGMENT PRINTING—Insolubilized Starch (U.S. P. 2,401,755) .717 (1946)
PIGMENT PRINTING—Polyvinyl Derivatives (Ger. P. 749,390) .460 (1946)
PIGMENT PRINTING—Starch Preparations (U. S. P. 2,413,320) 367 (1947)
PIGMENT PRINTING—Zein Dispersion (U. S. P. 2,396,430) ..398 (1946)
POLYAMIDE FIBERS—Dyed with Sulfur Dyestuffs (French P. 906,232) 153 (1947)
POLYMERS—Impregnating Fabrics with (Brit. P. 572,959) 337 (1946)
POLYVINYL FIBERS—Dyeing from Organic Solutions (French P. 865,918) 717 (1946)
PRINTING BLANKET (Can. P. 437,322) 155 (1947)
PRINTING—Device (Handprinting) (Brit. P. 572,980) 377 (1946)
PRINTING—Indigosols—adding Caffeine (U. S. P. 2,406,586) ..219 (1947)
PRINTING MECHANISM—Back greys omitted (U. S. P. 2,404,350) 16 (1947)
PRINTING NECKTIES (U. S. P. 2,400,700) 475 (1946)
PRINTING—Relief Designs (U. S. P. 2,416,997-8) 366 (1947)
PRINTING ROLLER—having only a thin copper layer (Ger. P. 749,802) 461 (1946)
PRINTING VAT DYESTUFFS — Organic Phosphates added (French P. 863,256) 458 (1946)
PRINTING VAT DYESTUFFS—Stabilized by Anthraquinoid Compounds (U. S. P. 2,405,151) 37 (1947)
PROTEIN CONDENSATES—as Flameproofing Agents (U. S. P. 2,413,163) 338 (1947)
PROTEIN DEGRADATION PRODUCTS—"Lamepones" after-treated (Ger. P. 748,564) 459 (1946)
PROTEIN DEGRADATION PRODUCTS—Detergents (U. S. P. 2,398,317) 458 (1946)
PROTEIN FIBERS — Synthetic; dyeing uniformly with wool (U. S. P. 2,412,125-26) 283 (1947)
QUATERNARY COMPOUNDS—Crease Resistant Finish (U. S. P. 2,397,451) 398 (1946)
RAYON YARNS—Pre-treatment (Brit. P. 574,182) 377 (1946)
RESIN CONDENSATES—Fixation of Printed Dyestuffs (Ger. P. 750,397) 312 (1947)
RESIN FINISHES—Fixed by Superheated Steam (Brit. P. 577, 982) 100 (1947)
RUBBERIZED TEXTILE FABRICS (Brit. P. 577,291) 249 (1947)
RUBBERIZED VISCOSE YARNS (French P. 913,230) 336 (1947)
SCHIFF-BASES—for Rendering Fabrics Water Repellent (U. S. P. 2,413,024) 338 (1947)
SHRINKING DEVICE (U. S. P. 2,409,543) 219 (1947)
SHRINKING WOOLEN FABRICS—Steam Chamber (Brit. P. 578,389) 100 (1947)
SHRINKPROOFING WOOL—Peroxide Treatment (Brit. P. 579,584) 249 (1947)
SHRINKPROOFING—Wool (U. S. P. 2,395,791) 336 (1946)
SHRINKPROOFING—Wool (Brit. P. 572,041) 337 (1946)
SHRINKPROOFING WOOL—Chlorites plus Acids (Australian P. 121,074) 311 (1947)
SHRINKPROOFING WOOL—Treatment with unsaturated Hydrocarbon Compounds (U. S. P. 2,406,958) 37 (1947)
SHRINKPROOFING—Wool cont. textiles (U. S. P. 2,395,724) ..336 (1946)
SHRINKPROOFING WOOL—Vinyl Polymers (French P. 911,-855) 336 (1947)
SIZING WITH POLYMERIZED PRODUCTS (Brit. P. 572,-844) 475 (1946)
SLIPPROOFING—Textiles (Brit. P. 574,644) 377 (1946)
STABILIZING—Cellulosic Textiles (Shrinkproofing) (U. S. P. 2,412,832) 337 (1947)
STABILIZING — Pre-treatment Cellulosic Yarns (U. S. P. 2,411,429) 248 (1947)
STABILIZING—Rayon Fabrics (U. S. P. 2,409,894) 281 (1947)
STABILIZING — Urea-Formaldehyde Condensates (U. S. P. 2,406,217-18) 153 (1947)
STARCH COMPOSITIONS—non gelling (U. S. P. 2,400,402) .440 (1946)
STARCH ESTERS (U. S. P. 2,412,213) 337 (1947)
STARCH GLYCOLATE—Finishes (Swiss P. 240,219) 457 (1946)
STARCH PASTES—Increasing Viscosity (U. S. P. 2,407,071. 99 (1947)
STARCH—Thick Boiling (U. S. P. 2,401,813) 718 (1946)
STARCH TREATMENT—High Frequency Waves (Brit. P. 579,702) 288 (1947)
STARCH TREATMENT—Stable Thickeners (U. S. P. 2,400,820) 440 (1946)
STATIC ELECTRICITY—Prevention (Brit. P. 576,365) 503 (1946)
STIFFENING FELT HATS—Zein Solutions (U. S. P. 2,413,229) 366 (1947)
TALL OIL—Treatment (U. S. P. 2,396,471) 398 (1946)
TENTER FRAME WITH ADJUSTABLE WALLS (Brit. P. 578,735) 280 (1947)
TRANSPARENTIZING FABRICS—Combining with Mercerizing Treatments (Brit. P. 577,233) 100 (1947)
VAT DYED FABRICS—Preventing Tendering on Light (Brit. P. 582,143) 336 (1947)
VAT DYES—Pigment Dyeing (Ger. P. 748,974) 459 (1946)
VINYON YARN—Dyeing (U. S. P. 2,394,688-9) 336 (1946)

WATER—Purifying (Brit. P. 573,408) 376 (1946)
WATERPROOFING—Cellulosic Material (U. S. P. 2,394,537) .. 336 (1946)
WATERPROOFING NYLON — Zelane Treatment (Brit. P. 577,433) 101 (1947)
WATERPROOFING TEXTILES — Benzoic Acid Substitute (U. S. P. 2,398,272) 504 (1946)
WATERPROOFING TEXTILES—Increase of Emulsions Stability (U. S. P. 2,402,351) 504 (1946)
WATERPROOFING TEXTILES — Nitro-esters (U. S. P. 2,402,776) 718 (1946)
WATER REPELLENT FABRICS—Ketenes used (U. S. P. 2,411,860) 288 (1947)
WATER REPELLENT FABRICS—Wax and Aluminum Salts (French P. 864,640) 458 (1946)
WATER REPELLENT FABRICS — Zirconium Compounds (French P. 905,659) 154 (1947)
WATER REPELLENT FABRICS—Zirconium Soaps (U. S. P. 2,402,857) 719 (1946)
WOOL—Regain of Moisture (U. S. P. 2,401,926-27) 504 (1946)
ZEIN—for Finishing (U. S. P. 2,402,128) 504 (1946)

PATENT INDEX

U. S. Pat. 2,417,570 (Solvay Proc. Co.) 367 (1947)
U. S. Pat. 2,417,312 (Courtaulds) 367 (1947)
U. S. Pat. 2,416,997-8 (Aspinook Corp) 366 (1947)
U. S. Pat. 2,416,988 (Tootal Broadhurst Lee) 366 (1947)
U. S. Pat. 2,416,884 (du Pont) 388 (1947)
U. S. Pat. 2,416,620 (Interchem. Corp) 366 (1947)
U. S. Pat. 2,413,983 (Bruce et al) 337 (1947)
U. S. Pat. 2,413,428 (Monsanto Chem. Co.) 366 (1947)
U. S. Pat. 2,413,320 (Stein, Hall & Co.) 367 (1947)
U. S. Pat. 2,413,229 (B. Stetson Co.) 366 (1947)
U. S. Pat. 2,413,163 (du Pont) 338 (1947)
U. S. Pat. 2,413,024 (Sun Chemical Co.) 338 (1947)
U. S. Pat. 2,412,832 (Cluett, Peabody) 337 (1947)
U. S. Pat. 2,412,282 (Essential Oil Producers) 337 (1947)
U. S. Pat. 2,412,213 (M. G. Groen) 337 (1947)
U. S. Pat. 2,412,125-26 (Collins and Aikman Corp) 283 (1947)
U. S. Pat. 2,411,860 (Heberlein Patents Corp.) 288 (1947)
U. S. Pat. 2,411,818 (Heberlein) 248 (1947)
U. S. Pat. 2,411,725 (B. Stetson Comp.) 248 (1947)
U. S. Pat. 2,411,429 (Courtaulds Ltd.) 248 (1947)
U. S. Pat. 2,411,414 (P. Cook) 218 (1947)
U. S. Pat. 2,410,395 (Sylvania Industrial Corp.) 281 (1947)
U. S. Pat. 2,409,980 (Eastman Kodak Co.) 283 (1947)
U. S. Pat. 2,409,894 (Cluett, Peabody & Co.) 281 (1947)
U. S. Pat. 2,409,703-04 (Celanese Corp.) 288 (1947)
U. S. Pat. 2,409,543 (Munsingwear, Inc.) 219 (1947)
U. S. Pat. 2,409,257 (Celanese) 248 (1947)
U. S. Pat. 2,408,527 (Petrolite Corp.) 155 (1947)
U. S. Pat. 2,407,988-89 (Luckite Proc.) 156 (1947)
U. S. Pat. 2,407,668 (Leatherman) 154 (1947)
U. S. Pat. 2,407,635 (Engler-Hand-Koletzko) 155 (1947)
U. S. Pat. 2,407,602 (Courtaulds Ltd.) 154 (1947)
U. S. Pat. 2,407,589 (Wyandotte Chem. Corp.) 154 (1947)
U. S. Pat. 2,407,071 (Staley Mfg. Co.) 99 (1947)
U. S. Pat. 2,406,958 (du Pont) 37 (1947)
U. S. Pat. 2,406,779 (U. S. Rubber) 153 (1947)
U. S. Pat. 2,406,749 (du Pont) 153 (1947)
U. S. Pat. 2,406,217-18 (Harvel Research) 153 (1947)
U. S. Pat. 2,406,586 (Allied Chem. & Dye) 219 (1947)
U. S. Pat. 2,405,665 (Rocco Nazzaro) 37 (1947)
U. S. Pat. 2,406,453 and 2,406,454 (Imper. Chem. Ind.) 99 (1947)
U. S. Pat. 2,406,407 and 2,406,408 (Celanese Corp.) 99 (1947)
U. S. Pat. 2,405,857 (Borne Scrymser Co.) 38 (1947)
U. S. Pat. 2,405,151 (Am. Cyanamid-Kienle-) 37 (1947)
U. S. Pat. 2,404,350 (Aspinook Corp.) 16 (1947)
U. S. Pat. 2,403,945 (Pacific Mills) 17 (1947)
U. S. Pat. 2,403,900 (Amer. Aniline) 16 (1947)
U. S. Pat. 2,403,630 (Westinghouse El. Co.) 38 (1947)
U. S. Pat. 2,403,019 (Brit. Celanese) 17 (1947)
U. S. Pat. 2,401,813 (Corn Prod. Ref.) 718 (1946)
U. S. Pat. 2,402,776 (Commerc. Solvents Corp.) 718 (1946)
U. S. Pat. 2,401,755 (Stein, Hall & Co.) 717-8 (1946)
U. S. Pat. 2,402,652 (Sylvania) 719 (1946)
U. S. Pat. 2,402,857 (Titanium Alloy Man.) 719 (1946)
U. S. Pat. 2,402,621 (United Merchants & Manufacturers) 718 (1946)
U. S. Pat. 2,402,351 (du Pont) 504 (1946)
U. S. Pat. 2,402,128 (Staley Manuf.) 504 (1946)
U. S. Pat. 2,401,926-27 (Parks & Woolson Mach. Co.) 504 (1946)
U. S. Pat. 2,401,479 (Tootal Broadhurst) 457 (1946)
U. S. Pat. 2,401,440 (Monsanto Chem.) 440 (1946)
U. S. Pat. 2,401,240 (Industr. Rayon Corp.) 458 (1946)
U. S. Pat. 2,401,028 (U. S. Rubber) 440 (1946)
U. S. Pat. 2,400,820 (Rohm & Haas) 440 (1946)
U. S. Pat. 2,400,766 (Mc.Spadden-Cook) 476 (1946)
U. S. Pat. 2,400,700 (McCurrach-May) 475 (1946)
U. S. Pat. 2,400,543 (Dearborn Chem. Co.) 458 (1946)
U. S. Pat. 2,400,402 (General Mills) 440 (1946)
U. S. Pat. 2,399,627 (Celanese Corp.) 440 (1946)
U. S. Pat. 2,399,559 (Courtaulds Lim.) 439 (1946)
U. S. Pat. 2,398,317 (Montclair Res.) 458 (1946)
U. S. Pat. 2,398,272 (Monsanto Chem. Co.) 504 (1946)
U. S. Pat. 2,397,451 (Am. Cyanamid) 398 (1946)
U. S. Pat. 2,397,437 (Montclair Res.) 378 (1946)
U. S. Pat. 2,396,471 (Hercules Powder Co.) 398 (1946)
U. S. Pat. 2,396,430 (Interch. Corp.) 398 (1946)
U. S. Pat. 2,395,791 (Cluett, Peabody & Co.) 336 (1946)
U. S. Pat. 2,395,724 (Tootal Broadhurst Lee) 336 (1946)
U. S. Pat. 2,394,688-89 (Am. Viscose Corp.) 336 (1946)
U. S. Pat. 2,394,537 (H. Dreyfus) 336 (1946)
U. S. Pat. 2,394,493 (Owen Corning) 336 (1946)
U. S. Pat. 2,391,942 (du Pont) 336 (1946)
U. S. Pat. 2,391,710 (Buffalo El. Co.) 335 (1946)
Can. Pat. 438,681 (United Merchants & Manuf. Inc.) 336 (1947)
Can. Pat. 437,322 (Dewey & Almy) 155 (1947)
Brit. Pat. 582,143 (Soc. Chem. Ind. Basle) 336 (1947)
Brit. Pat. 581,436 (Heberlein & Co.) 367 (1947)
Brit. Pat. 579,718 (Brit. Celanese) 281 (1947)
Brit. Pat. 579,709 (Courtlands) 288 (1947)
Brit. Pat. 579,702 (Neumann) 288 (1947)
Brit. Pat. 579,584 (Bleacher's Ass.) 249 (1947)
Brit. Pat. 579,328 (Jordan-O'Neill) 280 (1947)
Brit. Pat. 579,258 (Fearnleys Dyers Ltd.) 280 (1947)
Brit. Pat. 578,802 (Musher Foundation) 280 (1947)
Brit. Pat. 578,735 (Dungler) 280 (1947)
Brit. Pat. 578,389 (Ansett) 100 (1947)
Brit. Pat. 578,212 (Brit. Celanese) 99-100 (1947)
Brit. Pat. 577,982 (Dunlop Rubber Company) 100 (1947)
Brit. Pat. 577,433 (Imp. Chem. Ind.) 101 (1947)
Brit. Pat. 577,291 (Callender's Cable) 249 (1947)
Brit. Pat. 577,256 (Monbiot) 249 (1947)
Brit. Pat. 577,233 (A. G. Cilander) 100 (1947)
Brit. Pat. 577,054 (Domsjoe A. B.) 249 (1947)
Brit. Pat. 576,909 and 576,910 (Mathieson Alkali Works) 100 (1947)
Brit. Pat. 576,793 (Imp. Chem. Ind.) 504 (1946)
Brit. Pat. 576,562 (Geigy A. G.) 503 (1946)
Brit. Pat. 576,365 (du Pont) 503 (1946)
Brit. Pat. 576,050 (British Nylon Spinners) 503 (1946)
Brit. Pat. 575,964 (Courtlands Ltd.) 503 (1946)
Brit. Pat. 575,949 (Elliott and Blackman) 503 (1946)
Brit. Pat. 575,903 (Brit. Celanese) 503 (1946)
Brit. Pat. 575,903 (Brit. Celanese) 476 (1946)
Brit. Pat. 575,531 (Am. Viscose) 476 (1946)
Brit. Pat. 575,379 (Kingan et al) 476 (1946)
Brit. Pat. 575,264 (Dunlop Rubber Co.) 475 (1946)
Brit. Pat. 575,148 (Callender-Suchy) 475 (1946)
Brit. Pat. 575,072 (Courtlands, Ltd.) 475 (1946)
Brit. Pat. 575,028 (Knaggs) 474 (1946)
Brit. Pat. 574,828 (Imp. Chem. Ind.) 474 (1946)
Brit. Pat. 574,814 (Sylvania Industr. Corp.) 474 (1946)
Brit. Pat. 574,785 (Imp. Chem. Ind) 399 (1946)
Brit. Pat. 574,644 (Soc. Ch. Ind. Basle) 377 (1946)
Brit. Pat. 574,548 (Clifford-Shaw) 377 (1946)
Brit. Pat. 574,182 (Courtlands) 377 (1946)
Brit. Pat. 573,855 (Freiberg) 376 (1946)
Brit. Pat. 573,834 (Imp. Chem. Ind.) 377 (1946)
Brit. Pat. 573,574 (Calico Print. Ass.) 376 (1946)
Brit. Pat. 573,558 (Imp. Chem. Ind.) 376 (1946)
Brit. Pat. 573,471 (Jordan) 377 (1946)
Brit. Pat. 573,432 (Signer) 377 (1946)
Brit. Pat. 573,408 (Shell Developm.) 376 (1946)
Brit. Pat. 573,250 (Kenyon) 376 (1946)
Brit. Pat. 572,980 (Tschekmejan) 377 (1946)
Brit. Pat. 572,906 (du Pont) 475 (1946)
Brit. Pat. 572,868 (Oel & Chemie Werke) 337 (1946)
Brit. Pat. 572,136 (du Pont) 337 (1946)
Brit. Pat. 572,844 (Brit. Celanese) 475 (1946)
Brit. Pat. 572,041 (du Pont) 337 (1946)
Australian Pat. 121,131 (Noble) 311 (1947)
Australian Pat. 121,074 (I. C. I. of Australia and New Zealand) 311 (1947)
Swiss Pat. 238,525 (Suhner & Co.) 311 (1947)
Swiss Pat. 240,219 (F. Supf.) 457 (1946)
Swiss Pat. 240,201 (Bata A. G.) 457 (1946)
Swiss Pat. 238,151 (Bata) 311 (1947)
French Pat. 913,230 (Courtlauds Ltd.) 336 (1947)
French Pat. 911,855 (Montclair Research Corp.) 336 (1947)
French Pat. 906,232 (I. G. Farbenind.) 153 (1947)
French Pat. 905,659 (Hydrierwerke) 154 (1947)
French Pat. 905,534 (Geigy Comp.) 154 (1947)
French Pat. 865,918 (Rhodiaceta) 717 (1946)
French Pat. 865,903 (Soc. Ind. Chim, Basle) 717 (1946)
French Pat. 865,783 (Albertini-Lanfangroni) 717 (1946)
French Pat. 864,640 (Chem. Fabr. Pfersee) 458 (1946)
French Pat. 864,099 and 864,100 (Heberlein & Co.) 457 (1946)
French Pat. 863,256 (I. G. Farbenind.) 458 (1946)
Danish Pat. 64,897 (A. Th. Boehme) 249 (1947)
Danish Pat. 64,932 (Graf) 249 (1947)
German Pat. 749,928 (Anonym.) 311 (1947)
German Pat. 749,804 (Ulrich) 460 (1946)
German Pat. 749,802 (Anon.) 461 (1946)
German Pat. 749,708 (Kaestner) 460 (1946)
German Pat. 750,397 (I. G. Farbenind.) 312 (1947)
German Pat. 749,390 (I. G. Farbenind.) 460 (1946)
German Pat. 749,387 (Gerstner) 460 (1946)
German Pat. 749,151 (Anon.) 460 (1946)
German Pat. 749,082 (Anon.) 460 (1946)
German Pat. 749,051 (Courtaulds) 459
German Pat. 748,974 (Stockhausen) 459 (1946)
German Pat. 748,836 (I. G. Farbenind.) 459 (1946)
German Pat. 748,632 (A. Th. Boehme) 459 (1946)
German Pat. 748,564 (Chem. Fabrik Gruenau) 459 (1946)
German Pat. 748,450 (Anon.) 459 (1946)
German Pat. 748,449 (Chemopharm, Beyer) 458 (1946)
Austrian Pat. 159,421 (Pott) 378 (1946)
Austrian Pat. 158,996 (Imp. Chem. Ind.) 377 (1946)
Austrian Pat. 159,297 (I. G. Farben) 378 (1946)

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Friction Between Keratin Surfaces as Affected by Some Skrinkproofing Treatments*

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Summary

The results of the present experiments show that it is not necessary to alter the physical structure of the fiber scales in order to reduce their D.F.E. on a smooth keratin surface. Treatment of the keratin surface alone with certain of the reagents used for reducing shrinkability will bring about the necessary reduction. These findings therefore support the views of Martin[2] (1944) in indicating that the D.F.E. is not simply the physical result of scaliness. They also show that when dealing with fiber surfaces in which the coefficients of friction are very low, the D.F.E. is not as important in interpreting results as the actual value for the coefficients of friction in each direction.

Finally, they emphasize the need to have both keratin surfaces treated by the different reagents when observing the effect of the latter on the wool fiber surface. With both surfaces treated it has been found that all the reagents used for reducing shrinkability, except alcoholic caustic potash, markedly reduce the with-scale and anti-scale coefficients. Alcoholic caustic potash, on the other hand, increases the value of each.

Introduction

WOOL and other animal fibers show a greater frictional resistance when rubbed from tip to base than from base to tip. Monge[1] (1790) appears to have been the first to record this fact, attributing it to an overlapping scale structure in the fibers, which was used to explain the felting properties of wool. This explanation of felting, based on unidirectional migration of fibers due to their physical surface properties or scaliness, has dominated the ideas of subsequent workers. Recently, however, Martin[2] (1944) has advanced the view that the difference in frictional properties is not so much due to the physical structure of the scales as to their surface chemical composition. In support of this he quotes the lack of correlation between microscopic appearance of the scales and actual frictional measurements, and also the presence of a directional frictional effect (D.F.E.) in forms of keratin without scales, e.g. finger nails and polished porcupine quills. In addition, there is the fact that certain wools which have been made non-felting still possess a scale structure, but little or no D.F.E.

For the actual determination of the surface frictional properties of wool fibers, several methods have been used. Speakman and Stott[3] (1931) described an apparatus for examining the frictional properties of one wool surface against another which made use of the inclined plane technique. Fifty fibers were mounted on a small wooden bow with their scales all pointing in the same direction. The measurements of friction were carried out using an inclined plane, the surface of which was covered with a trail pile-finished wool cloth. The method was later adapted by Speakman, Stott and Chang[4] (1933) to determine frictional properties in water. Whewell, Rigelhaupt and Selim[5] (1944) applied the inclined plane method to demonstrate that treatment of wool with certain of the commercial non-felting reagents brought about a reduction in the D.F.E. When wool was treated with a 0.2N solution of chlorine in carbon tetrachloride they showed that, although the D.F.E. was reduced, the actual values for the angles of friction increase. A full report of their experiments was not available when the present paper was written.

Bohm[6] (1945) has also reported the results of experiments using groups of fibers (in the form of a uniform sheet of several hundred fibers) and sliding them against a glass surface.

Chamberlain and Speakman[7] (1942) described another method applicable to individual fibers which depends upon the tension developed by the migrating fiber as it is mechanically rubbed between two moving surfaces. This method was used by Barr and Speakman[8] (1944) to adduce evidence in support of their theory that unshrinkability produced by treatment with mercuric acetate or benzo-quinone was not due to a reduction in scaliness in the treated wools.

What is probably the most accurate method is that devised by Mercer[9] (1945), who used a modification of the stick-slip apparatus of Bowden and Leben[10] (1939) to examine the frictional properties of individual fibers. By using this apparatus, he showed that the D.F.E. is reduced when wool is treated by commercial unshrinkable processes. In general his results are in agreement with those of Whewell *et al.*[5], but differ in one respect. The latter workers recorded a decreased directional coefficient, but *increases* in actual frictional values when wool is treated with chlorine, whereas Mercer showed that the decrease in directional coefficient is due to substantial *decreases* in actual frictional values. Although Whewell *et al.* used a solution of chlorine in carbon tetrachloride in their experiments, whilst Mercer used an aqueous solution of chlorine, the differences in their results are such as to warrant further investigation. Further, both workers confined their measurements to the friction shown by treated wool fibers against surfaces which had not been treated by the reagents used for reducing shrinkability. This procedure is not strictly correct, as a study of the effect of reagents which produce non-felting properties should be concerned with the friction of treated fibers against each other. For this reason, the present investigations have included experiments in which frictional measurements have been made using treated fibers sliding on treated surfaces of keratin.

We first experimented with the inclined plane technique, but it was soon apparent that the time and patience required to fix the fibers on the sliding bow would not permit the carrying out of large numbers of measurements. As the equipment used in other methods was not readily available, a technique was devised using comparatively simple apparatus which was briefly described in an earlier paper by Lipson[11] (1945). It is proposed now to give a fuller description of the method.

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together with results of investigations on some of the problems outlined above.

Description of Apparatus

The apparatus needs no unusual equipment. The main requirement is a small cylindrical rod of keratin of 8 mm. approx. diameter. The rods used in the present experiments were turned from cattle horn. Two hooks, each weighing 0.1 g., are attached by means of molten shellac to either end of the fiber, which is then suspended over the rod. The solution in which the frictional determinations are required syphons from a conical flask on to the bulb of the thermometer and then drops on to the fiber-rod junction. A contents of the flask are heated until the thermometer above the rod records whatever experimental temperature is required. All the measurments described in this paper were carried out in a solution containing 0.2 per cent soap and 0.1 per cent sodium carbonate at 35° C., the *p*H value being 10.7. A bent glass rod placed in contact with the underside of the cylinder carries away the solution after use. During measurements the tap on the syphon is regulated so that the solution drops rapidly on to the fiber-rod junction.

In order to carry out a frictional determination, weights consisting of calibrated pieces of wire are gradually added to one of the hooks until the fiber commences to slide in that direction. As the initial movement of the fiber is extremely slow, it is desirable to use a magnifying eyepiece during observations. An observation is made 1 min. after the addition of each weight and, if no movement is shown, another weight is added. The experiment is then repeated, adding weights to the other hook and again carefully observing the commencement of sliding. The measurements are made to the nearest 0.01 g. The hooks are next removed and each is weighed, together with attached shellac. The total load indirection of motion (W_1) is the sum of added weights and the weight of hook plus shellac. The coefficient of friction in each direction is calculated from the formula for a sliding rope around a post. If W_2 is the weight of hook plus shellac on the other end of the fiber, then $\frac{W_1}{W_2} = e^{\mu\theta}$ (μ = coefficient of friction in direction of motion; and θ = angle subtended by normals from directions of W_1 and W_2).

As W_1 and W_2 are both vertical, $\theta = 180° = \pi$ radians and the expression can be simplified to $\mu = .736 \log^{10}\left(\frac{W_1}{W_2}\right)$

From this formula the coefficients of friction in either direction can be calculated. The above formula is applicable only if there is uniform contact between fiber and rod. That this is so is demonstrated by the gradual movement of the fiber when sliding occurs, which is usually of the order of 0.5 cm. per min. and often less.

Experimental

The wool used was prepared from a 64s quality Merino fleece of good length, uniformity and freedom from excessive dirt and vegetable materials. The fleece was purified by extraction with boiling petroleum ether (b.p. 50°-80° C.) to remove the wax, followed by extraction with warm distilled water to remove the suint. The small amount of residual dirt was allowed to fall out on opening the clean dry staples.

The keratin rods were prepared from the tips of cattle horns which had been turned on a lathe to cylinders of 8 mm. diameter. Departures from this diameter were found to have no serious influence upon the experimental results. It is desirable to have the surface of the keratin rod smooth, but not highly polished. In this way high values for the coefficients of friction are obtained and the order of accuracy of the method is thereby increased. Each horn sample before use was washed with ether, alcohol and distilled water.

Table I gives the results of frictional measurement using the same fiber, but with different samples of horn. It can be seen that there is good agreement between the figures obtained.

TABLE I

FRICTIONAL MEASUREMENTS OF ONE FIBER ON DIFFERENT SAMPLES OF HORN

Fiber	*Horn*	μ_1*	μ_2*	*D.F.E.**
No. 10	Sample A	0.35	0.11	0.52
No. 10	Sample B	0.30	0.13	0.40
No. 10	Sample C	0.31	0.13	0.41

* In all Tables μ_1 = anti-scale coefficient, μ_2 = with-scale coefficient, directional frictional effect (D.F.E.) $= \frac{\mu_1 - \mu_2}{\mu_1 + \mu_2}$

The unshrinkable treatments adopted throughout the work were as follows—

Sulfuryl Chloride—Treatment in a 2.5 per cent (by vol.) solution in carbon tetrachloride at 18°-19° C. for 1 hr., followed by washing with carbon tetrachloride, rinsing in water, neutralizing in 0.1 per cent sodium carbonate solution and finally washing thoroughly in water.

Alcohol Caustic Potash — Treatment was carried out with a 2 per cent solution in 95 per cent alcohol at 26° C. for 18 min. This was followed by washing in 95 per cent alcohol, neutralizing in 1 per cent (by vol.) alcohol sulfuric acid, washing in water, and finally treating with 0.1 per cent sodium carbonate solution and washing thoroughly in water.

Aqueous Bromine—The fibers being examined were made up in weight to 1 g. by the addition of more wool, the fibers under test being kept separate by attaching them to glass rods. Treatment was with 6 per cent bromine on the weight of wool in 200 ml. of water at 19° C. for 1 hr., after which the wool was washed in water and placed in 1 per cent sodium bisulfite solution. This was followed by washing in water, treating with 0.5 per cent sodium bicarbonate and again washing with water.

Aqueous Chlorine — The conditions were as for aqueous bromine, the chlorine solution for treating 1 g. wool being prepared by adding 50 ml. of 0.1N-hydrochloric acid to the requisite amount of 4 per cent sodium hypochlorite solution and making up to 200 ml. with water.

Chlorine in Carbon Tetrachloride — Treatment was with 0.2N-chlorine in carbon tetrachloride, using 1 g. wool in 20 ml. reagents and proceeding as with wet bromine. The wool was washed with carbon tetrachloride after chlorination and before treatment with sodium bisulfite.

In those experiments in which the cylinders of horn were treated, the conditions of treatment were the same as for wool.

Effects of Unshrinkable Treatments

The first series of experiments was designed to observe the effect when the horn and not the fiber was treated with the reagents used for reducing shrinkability. This was carried out by determining the friction of three separate fibers against a horn sample, then treating the latter with one of the reagents and repeating the frictional measurements. The effects of five of the unshrinkable processes on five different samples of horn were thereby observed using five different groups of fibers.

The results recorded in Table II show clearly that treatment of the horn samples with the various reagents has in all instances significantly lowered the apparent directional coefficients of all the fibers. Sulfuryl chloride, bromine, and chlorine have all reduced the anti-scale coefficients of friction to below one-quarter of their original values. With alcoholic caustic potash the reduction is to about one-half of the original values. The with-scale coefficients of friction have also been significantly reduced in treating with sulfuryl chloride and the halogens, but not with alcoholic caustic potash. The figures for D.F.E. should be accepted

TABLE II
EFFECT OF HORN TREATMENT ON FRICTIONAL MEASUREMENTS (FIBERS UNTREATED)

Fiber	*Horn*	*Treatment of Horn*	μ_1	μ_2	*D.F.E.*
No. 1	Sample A	Untreated	0.34	0.11	0.51
No. 2	Sample A	Untreated	0.37	0.24	0.21
No. 3	Sample A	Untreated	0.40	0.14	0.48
No. 1	Sample A	Sulfuryl chloride	0.04	0.04	0.00
No. 2	Sample A	Sulfuryl chloride	0.09	0.07	0.13
No. 3	Sample A	Sulfuryl chloride	0.06	0.05	0.09
No. 4	Sample B	Untreated	0.31	0.14	0.38
No. 5	Sample B	Untreated	0.28	0.15	0.30
No. 6	Sample B	Untreated	0.34	0.16	0.36
No. 4	Sample B	Alcoholic caustic potash	0.14	0.10	0.17
No. 5	Sample B	Alcoholic caustic potash	0.14	0.11	0.12
No. 6	Sample B	Alcoholic caustic potash	0.14	0.12	0.08
No. 7	Sample C	Untreated	0.34	0.14	0.42
No. 8	Sample C	Untreated	0.42	0.16	0.45
No. 9	Sample C	Untreated	0.35	0.14	0.43
No. 7	Sample C	Aqueous bromine	0.07	0.07	0.00
No. 8	Sample C	Aqueous bromine	0.08	0.05	0.23*
No. 9	Sample C	Aqueous bromine	0.06	0.05	0.09
No. 23	Sample D	Untreated	0.25	0.09	0.47
No. 24	Sample D	Untreated	0.32	0.04	0.78
No. 25	Sample D	Untreated	0.36	0.13	0.47
No. 23	Sample D	Aqueous chlorine	0.03	0.02	0.20*
No. 24	Sample D	Aqueous chlorine	0.04	0.02	0.33*
No. 25	Sample D	Aqueous chlorine	0.04	0.04	0.00
No. 26	Sample E	Untreated	0.31	0.09	0.55
No. 27	Sample E	Untreated	0.32	0.12	0.46
No. 28	Sample E	Untreated	0.40	0.18	0.38
No. 26	Sample E	Chlorine in carbon tetrachloride	0.04	0.02	0.33*
No. 27	Sample E	Chlorine in carbon tetrachloride	0.09	0.05	0.29*
No. 28	Sample E	Chlorine in carbon tetrachloride	0.10	0.06	0.25*

* As explained in the text, these high figures are not significant as the actual frictional values are so low.

TABLE III
EFFECT ON FRICTIONAL MEASUREMENTS OF TREATMENTS IN CARBON TETRACHLORIDE

Fiber	*Treatment of Horn*	μ_1	μ_2	*D.F.E.*
No. 11	Untreated	0.43	0.17	0.43
No. 12	Untreated	0.34	0.13	0.45
No. 13	Untreated	0.36	0.15	0.41
No. 11	Carbon tetrachloride	0.43	0.18	0.41
No. 12	Carbon tetrachloride	0.36	0.13	0.47
No. 13	Carbon tetrachloride	0.34	0.13	0.45

TABLE IV
EFFECT OF FIBER TREATMENT ON FRICTIONAL MEASUREMENTS (HORN UNTREATED)

Fiber	*Horn*	*Treatment of Fiber*	μ_1	μ_2	*D.F.E.*
No. 14	Sample F	Untreated	0.35	0.15	0.40
No. 15	Sample F	Untreated	0.24	0.13	0.30
No. 16	Sample F	Untreated	0.37	0.14	0.45
No. 14	Sample F	Sulfuryl chloride	0.25	0.23	0.04
No. 15	Sample F	Sulfuryl chloride	0.28	0.28	0.00
No. 16	Sample F	Sulfuryl chloride	0.26	0.24	0.04
No. 17	Sample F	Untreated	0.39	0.19	0.35
No. 18	Sample F	Untreated	0.36	0.14	0.44
No. 40	Sample G	Untreated	0.35	0.15	0.40
No. 17	Sample F	Alcoholic caustic potash	0.68	0.43	0.23
No. 18	Sample F	Alcoholic caustic potash	0.67	0.41	0.24
No. 40	Sample F	Alcoholic caustic potash	0.65	0.46	0.17
No. 20	Sample F	Untreated	0.36	0.14	0.44
No. 21	Sample F	Untreated	0.34	0.15	0.39
No. 22	Sample F	Untreated	0.33	0.13	0.44
No. 20	Sample F	Aqueous bromine	0.22	0.20	0.05
No. 21	Sample F	Aqueous bromine	0.20	0.17	0.08
No. 22	Sample F	Aqueous bromine	0.23	0.14	0.24
No. 25	Sample G	Untreated	0.40	0.15	0.45
No. 34	Sample G	Untreated	0.29	0.15	0.32
No. 35	Sample G	Untreated	0.33	0.12	0.47
No. 25	Sample G	Aqueous chlorine	0.38	0.30	0.12
No. 34	Sample G	Aqueous chlorine	0.31	0.29	0.03
No. 35	Sample G	Aqueous chlorine	0.34	0.31	0.05
No. 28	Sample G	Untreated	0.39	0.16	0.42
No. 31	Sample G	Untreated	0.32	0.15	0.36
No. 32	Sample G	Untreated	0.36	0.16	0.39
No. 28	Sample G	Chlorine in carbon tetrachloride	0.35	0.34	0.01
No. 31	Sample G	Chlorine in carbon tetrachloride	0.43	0.41	0.02
No. 32	Sample G	Chlorine in carbon tetrachloride	0.37	0.35	0.03

with reserve, since with coefficients of friction approaching zero, small variations cause marked differences in the D.F.E. This is evident in fibers No. 24 and No. 25 in the experiments using aqueous chlorine. The former has a D.F.E. of 0.33, whereas that of the latter is zero. Yet it is doubtful whether there is any major difference between the two fibers, each of which shows an extremely low coefficient of friction, both with and against the scales.

The main point emerging from these results is that it is not necessary to treat the fiber themselves in order to obtain reduced values for their directional frictional effects. Treatment of the smooth horn surface with the reagents used for reducing shrinkability will do this. These findings therefore support Martin's view that the imbrication of the scales is not the main factor responsible for the D.F.E. The chemical structure of the keratin surfaces appears to be a most important factor in the friction between them.

In order to make sure that the above changes in frictional properties are due to the actual reagents used for reducing shrinkability and not to some effect of the neutralizing agents or solvents, a control experiment was carried out. A sample of horn was immersed in carbon tetrachloride at 18°-19°C. for 1 hr. and then given the same neutralizing treatment as in the sulfuryl chloride process described earlier. The results of frictional measurements made with the same fibers on the horn before and after treatment are given in Table III.

It is seen that there is no alteration in frictional properties, which proves that the changes recorded above cannot be explained simply by an action of the solvent or neutralizing agents.

The second series of experiments was planned to study the effect of fiber treatment on the D.F.E., the horn remaining untreated. The results obtained from these experiments can therefore be used as a basis for comparison with those of earlier workers who have treated the fibers only. The present experiments have the advantage that the measurements were carried out on the same fibers both before and after the various treatments. This procedure is desirable as it has been found that the variations in frictional properties shown by fiber from the same origin can at times be quite substantial. The results of these experiments are given in Table IV.

The figures show that sulfuryl chloride has greatly raised the with-scale coefficients of friction and, with the exception of one fiber (No. 15), there has been a decrease in anti-scale friction. The D.F.E. approaches zero in each instance. Alcoholic caustic potash has raised the anti-

(Continued on Page 475)

Felt Resistant Wool by Wet Chlorination*

HARRY ZIMMERMAN

Alrose Chemical Co.

DURING the last few years the wet chlorination of wool has been reinvestigated, not only in the light of our present-day knowledge of the chemical and physical structure of wool, but also of our increased knowledge of the chemistry of chlorinating solutions, and of the large number of new chemicals at our disposal. A very limited number of these new chemicals have shown promise as chlorinating agents for wool.

Chemistry of the Chlorinating Bath

Commercial soda bleach (sodium hypochlorite) is the most widely used source of chlorine for chlorinating wool. It is obtained by bubbling chlorine into a cold caustic soda solution, and is sold on the basis of active chlorine content. The reaction is an equilibrium, readily reversed by addition of acid:

$$2NaOH + Cl_2 \rightleftharpoons NaOCl + NaCl + H_2O$$

Sodium hypochlorite loses chlorine slowly on standing and it should therefore always be checked for strength before use. The chlorine exists in different chemical forms depending on the pH of the solution. At a pH of above 9.0 it exists solely as OCl^- ion. At a pH of about 5.5 it is all in the form of hypochlorous acid HOCl. At a pH of 2.0 the chlorine is completely liberated as nascent chlorine.

The chemistry of chlorinating baths is complicated by the fact that hypochlorite may show a number of different types of reactions. In relatively neutral solutions, hypochlorous acid acts as an oxidizing agent, liberating oxygen at a rate dependent on temperature and catalysts present:

$$2\ HOCl \longrightarrow O_2 + 2HCl$$

In strongly acid solutions, nascent chlorine is liberated.

$$HOCl + HCl \rightleftharpoons 2Cl + H_2O$$

Under such conditions, direct chlorination may occur, particularly in the presence of catalysts. Chlorination of amide or amine nitrogen atoms can also occur, and the stability of these compounds varies widely depending on their structure.

Other reactions such as addition to unsaturated carbon-carbon linkages in impurities and oxidation of other materials present in the bath may complicate matters further.

Control of Chlorinating Bath

Using the old conventional method of chlorinating by treating the wool with an aqueous solution of bleaching powder acidified with strong mineral acid, it is impossible to avoid the presence of free chlorine in the bath and even small quantities of chlorine will cause damage. Since the exhaustion of chlorine even in the cold is a matter of seconds, it is impossible to obtain a uniform treatment. Some of the fibers are overtreated and others are not treated at all.

Using hypochlorous acid, obtained by carefully adjusting the pH, better results are obtainable, but such solutions are difficult to prepare and rapidly undergo decomposition. In the presence of wool the pH of the bath rapidly falls due to the formation of hydrochloric acid, and free chlorine is liberated. Also the wool is yellowed considerably.

It was realized from the start that to overcome some of these difficulties the chlorinating bath would have to be controlled so as to liberate chlorine more slowly under conditions which do not damage the wool.

In some processes this is accomplished by careful control of the pH of the bath, temperature, concentration, rate of addition and the type of acid used. By these methods satisfactory results are often obtained. However, in many cases the wool is yellowed and the felting resistance is not permanent.

In some instances the chlorination is superficial and after a few washings the wool begins to felt.

The problem of obtaining uniform chlorination throughout the fiber with no yellowing has now been solved by the use of certain chlor-sulfonamides in acid solution (Patents pending in U. S., Canada and other countries). At a pH below 2 the chlorsulfonamide solution is quite stable in the absence of wool. When wool is entered into the solution at room temperature chlorination slowly takes place, and this reaction is accelerated with increased temperature.

The time taken for exhaustion of chlorine can be conveniently adjusted by varying the temperature from room temperature to 140° F. so as to be complete in 15 to 45 minutes. The rate of chlorine exhaustion depends also on the type and quality of yarn, how spun and on the fabric construction.

Stability of Chlorinating Baths

The extremely rapid release of chlorine from acidified hypochlorite baths is recognized to be the cause of most of the difficulties in obtaining reproducible results in the past. Since much of the chlorine is lost to the atmosphere, the process is not only difficult to reproduce but is also very irritating to the operator.

If the chlorine is added in the form of the aforementioned sulfonamides, the bath is relatively stable and releases no chlorine to the atmosphere, but exhausts uniformly in contact with wool.

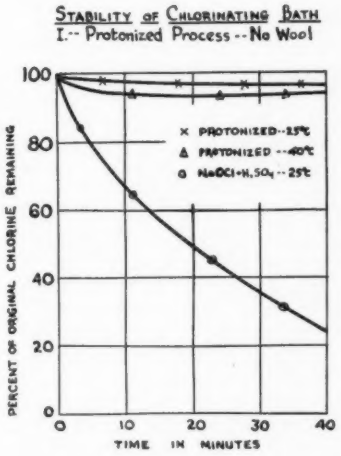


Figure 1

Figure 1 illustrates the stability of such chlorinating baths at 25° C. and 40° C. in absence of wool fibers. Titrations show no appreciable loss in available chlorine over a period of 40 minutes at either temperature. By contrast, the older type acidified hypochlorite bath shows rapid loss in chlorine (lower curve).

Figure 2 shows the rate of chlorine exhaustion after wool is entered into the chlorinating bath. The acidified hypo-

* A portion of an address before the Canadian Association of Textile Chemists and Colorists, April 12, 1947.

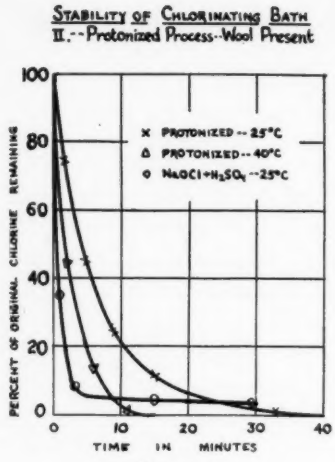


Figure 2

chlorite bath is almost completely exhausted in 2 or 3 minutes, while the special chlor-sulfonamide bath is exhausted at a uniform rate in about 15 to 20 minutes (the time varies with the type of wool). This rate is increased at 40° C. In practical processing, advantage is taken of this effect by chlorinating 10 minutes at room temperature to exhaust most of the chlorine, and then raising the temperature to obtain 95% to 98% exhaustion in a reasonable time.

The lower curve shows that the acidified hypochlorite bath exhausts almost instantaneously in the presence of wool, and is hence totally uncontrollable by comparison with the upper curves.

Amount of Chlorine Required for Stabilization

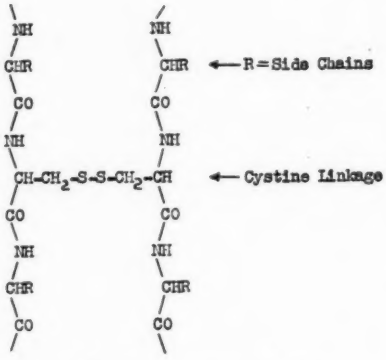
The percentage of chlorine required depends on many factors and has first to be determined by laboratory trials. The quality of the wool is the most important factor; the coarser qualities require lower percentages and the finer grades require higher percentages of chlorine and more careful handling. Different chlorinating processes also require different quantities of chlorine for effective treatment, and the method of spinning, whether singles or plied yarn, the twist, stretch, prior treatment, and many other factors have a profound influence.

Another important consideration is the severity of wash tests or milling action the material is expected to withstand.

Since felting-resistance is a relative matter, and greater resistance is obtained with higher amounts of chlorine (and with increasing possibility of damage to the fiber), a compromise is usually sought. The amount of chlorine used should be just barely enough to obtain the desired degree of felting-resistance.

Nature of the Wool Fiber

Chemically, the wool fiber consists of a network of long polypeptide molecular chains linked together by occasional disulfide groupings. The long chains are studded with short side chains comprising nearly half the total molecular structure.



Molecular Structure of Wool

The crosslinkages and, to some degree, the side chains determine the physical and chemical properties of the wool fiber.

Physically, the wool fiber contains three structural components. First, surrounding the fiber, is the cuticle, which is only 2 or 3 microns thick and consists of overlapping microscopic scales. These scales have an amino-acid polypeptide structure similar to the remainder of the fiber, but have a much larger number of crosslinkages, hence they are tougher and more resistant to chemical attack then the balance of the fiber.

The main portion of the fiber consists of the fibrous cortical layer. Many types of wool fibers also have a central canal or medulla containing the pithy medullary cells.

Causes and Mechanism of Felting

While the causes of felting are still not completely known, it has been found that the outer scale layer is principally involved. It is believed that the outer layers of molecules are oriented at an angle to the surface, resulting in a difference in friction between the root direction and the tip direction. This is a measurable quantity known as the Differential Friction Effect (DFE). Owing to the elasticity of the fiber, and the DFE, the wool fibers become intertwined and matted on milling, until, after a time, it is impossible to separate them without breakage.

During this process marked shrinkage takes place. This unique characteristic of wool is known as "felting" and the formation of the entangled mass of "felt" is referred to as felting, fulling and milling shrinkage. This property is used to great advantage in the manufacture of such materials as hats, flannels, blankets, clothing, paper maker's felts, industrial felts such as gaskets, polishing blocks, etc.

For wearing apparel or materials that have to be laundered, the felting shrinkage of wool is its greatest disadvantage.

The degree of felting depends upon a number of factors including mechanical action, pH, temperature, type, quality of wool and fabric structure. In general, finer wools show the most felting, while some coarse wools show no felting at all. Various proportions of other spun fibers prevent felting by reducing the number of contacts between wool fibers.

Action of Chlorine and Effect on Felting

It is believed that chlorination attacks the disulfide linkages of the fiber splitting them to form cysteic acid groups.

$$—CH_2\text{-}S\text{-}S\text{-}CH_2 \text{ ———}$$
$$\text{-}CH_2SH + HS\,CH_2\text{-}$$

This alteration in chemical structure is accompanied by a disarrangement of the surface layers of the cuticle. This reduces the differential friction effect and the fiber is thenceforth much more resistant to felting.

The New Controlled Chlorination Process

Wool has been treated by the new sulfonamide process in the form of top, yarn in packages or skeins, knitted piece goods, hosiery, etc. Other fibers are unaffected and socks with elastic tops have been processed successfully.

The wool is first scoured thoroughly, after which it may be fulled to any desired degree before chlorination. It is then rinsed with hot water and finally with cold water.

To obtain satisfactory shrinkproofing of wool many factors have to be taken into consideration and the history of the wool before chlorination plays an important part. If the fibers have in any way been damaged by weathering or processing such as overbleaching or alkali damage caused by improper scouring, serious damage may result.

A wetting agent, sulfuric acid, and formaldehyde are charged into cold water in the machine, and the wool is wet out thoroughly. The hypochlorite is combined with the sulfonamide, and the resulting chlor-sulfonamide is added to the bath.

Sodium hypochlorite ("soda bleach") is the preferred source of chlorine. Since the commercial material has limited stability

and the chlorine content varies from one material shipment to another, it is important to titrate a sample before use to determine the "available chlorine" content.

For the coarser woolen materials, 3 per cent chlorine based on the weight of wool is usually adequate. For fine, high-quality worsteds, a larger amount of chlorine (4 per cent to 6 per cent) is required. The minimum quantity required for any particular type must be determined experimentally. It is interesting to note that wool treated with too little chlorine will often exhibit no noticeable increase in felting-resistance—hence, the importance of using no less than the predetermined minimum quantity of chlorine.

The machine is run 10 minutes in the cold, allowing most of the chlorine to exhaust (see graph of Fig. 2). The temperature is then raised to 110°-120°F. to complete the exhaustion of chlorine in about 30 to 45 minutes. The bath is dropped and a small amount of bisulfite is added to a fresh bath as an antichlor.

The goods are rinsed and neutralized carefully with bicarbonate or ammonia.

Results

Wool chlorinated by this process is whiter than the original and has a soft, resilient hand with good strength and abrasion resistance.

Microscopic examination of the fibers treated by the process described above shows no destruction of epithelial scale structure.

Wool chlorinated by the chlorsulfonamide process shows no appreciable alteration in dyeing characteristics.

TABLE V

EFFECT OF FIBER AND HORN TREATMENT ON FRICTIONAL MEASUREMENTS

Fiber	*Horn*	*Treatment of Fibre and Horn*	μ_1	μ_2	*D.F.E.*
No. 1	Sample A	Untreated	0.34	0.11	0.51
No. 2	Sample A	Untreated	0.37	0.24	0.21
No. 3	Sample A	Untreated	0.40	0.14	0.48
No. 1	Sample A	Sulfuryl chloride	0.12	0.10	0.09
No. 2	Sample A	Sulfuryl chloride	0.11	0.11	0.00
No. 3	Sample A	Sulfuryl chloride	0.11	0.10	0.05
No. 4	Sample B	Untreated	0.31	0.14	0.38
No. 5	Sample B	Untreated	0.28	0.15	0.30
No. 6	Sample B	Untreated	0.34	0.16	0.36
No. 4	Sample B	Alcoholic caustic potash	0.45	0.30	0.20
No. 5	Sample B	Alcoholic caustic potash	0.41	0.29	0.17
No. 6	Sample B	Alcoholic caustic potash	0.50	0.29	0.27
No. 7	Sample C	Untreated	0.34	0.14	0.42
No. 8	Sample C	Untreated	0.42	0.16	0.45
No. 9	Sample C	Untreated	0.35	0.14	0.43
No. 7	Sample C	Aqueous bromine	0.11	0.09	0.10
No. 8	Sample C	Aqueous bromine	0.08	0.08	0.00
No. 9	Sample C	Aqueous bromine	0.05	0.04	0.11
No. 25	Sample D	Untreated	0.36	0.13	0.47
No. 34	Sample G	Untreated	0.29	0.15	0.32
No. 35	Sample G	Untreated	0.33	0.12	0.47
No. 25	Sample D	Aqueous chlorine	0.04	0.02	0.33*
No. 34	Sample D	Aqueous chlorine	0.02	0.01	0.33*
No. 35	Sample D	Aqueous chlorine	0.03	0.03	0.00
No. 28	Sample E	Untreated	0.40	0.18	0.38
No. 31	Sample G	Untreated	0.32	0.15	0.36
No. 32	Sample G	Untreated	0.36	0.16	0.39
No. 28	Sample E	Chlorine in carbon tetrachloride	0.10	0.06	0.25*
No. 31	Sample E	Chlorine in carbon tetrachloride	0.14	0.06	0.40*
No. 32	Sample E	Chlorine in carbon tetrachloride	0.13	0.07	0.30*

* As explained in the text, these high figures are not significant as the actual frictional values are so low.

Friction Between Keratin Surfaces

(*Continued from Page 472*)

scale coefficients by about 75 per cent and has more than doubled the with-scale coefficients, but the D.F.E. is still substantial. The effect of aqueous bromine is somewhat similar to that of sulfuryl chloride, there being a drop in coefficients of friction against the scales and a slight tendency towards higher with-scale coefficients. There are no significant differences between the two chlorine treatments; both have greatly increased the with-scale coefficients and the anti-scale coefficients also tend to rise. The directional frictional effects approach zero for each of the chlorine treatments.

As already mentioned, a point which should not be overlooked is the effect on the frictional results when both rubbing surfaces have been treated with the reagent, which is what occurs in practice. A third series of experiments was therefore undertaken in which fibers and horn were treated by the different unshrinkable processes and the changes in frictional properties observed. The results of these experiments are recorded in Table V.

These results show that when both surfaces have been treated with either sulfuryl chloride or any of the three halogen processes, the coefficients of friction both with and against the scales drop to extremely low values. The high directional frictional effects given for some of the chlorine-treated fibers in Table V are due only to slight variations in actual frictional values. Little significance should be attached to the figures for D.F.E. when dealing with such low coefficients of friction, and it is the actual values of the coefficients that need to be considered. With this in view, the results clearly show that sulfuryl chloride and the halogens substantially reduce the anti-scale and with-scale coefficients to approximately the same values. Alcoholic caustic potash, on the other hand, increases the coefficient of friction against the scales by about 50 per cent and approximately doubles the coefficient of friction with the scales. Its effect is therefore different from that of each of the other reagents. In further support of this contention it has been observed that when a sample of horn is treated with sulfuryl chloride the surface becomes soft and gelatinous during the treatment. Also, in the treatment of horn samples with each of the three halogen processes, a similar surface effect occurs during the rinse with sodium bicarbonate solution. On the other hand, with alcoholic caustic potash no such effects are noted at any stage of the treatment.

Speakman and Goodings[2] (1926) have recorded the formation of a jelly layer between the cortex and cuticle of wool fibers by the consecutive action of aqueous chlorine and soap or soda (the Allwörden reagent). Our observations on horn therefore agree with their results on wool fibers in showing that subsequent treatment with alkali is necessary in order to produce gelatinization during halogen treatment. From the observations recorded above that the sulfuryl chloride solution itself will gelatinize horn surface, it should follow that the fiber surfaces are gelatinized in this reagent prior to their treatment with alkali. Alcoholic caustic potash, on the other hand, should not produce any surface gelatinization of the fibers.

Our thanks are due to the Central Wool Committee for permission to publish this paper. We also thank M. R. Freney, Officer in Charge of the Central Wool Committee Testing House, for his interest the manuscript. Acknowledgment is made of the cooperation of A. C. Marshall, Meat Commissioner for New South Wales, who has kindly provided the samples of horn used in these experiments.

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ABSTRACTS
FROM CONTEMPORARY JOURNALS

Annual Meeting

Journal of the Society of Dyers and Colourists, page 125, Vol. 63, No. 5, May, 1947

The 63rd Annual General Meeting of the Society of Dyers and Colourists was held at the Victoria Hotel, Bradford, March 28th, 1947. A number of items reported at this meeting will be of interest to REPORTER readers.

The membership of the Society increased by 600 members. (AATCC membership to May 1st, 1947 increased by 515 members). The formation of a section in Northern Ireland was reported as well as the revival of the Bradford Junior Branch.

The following publications were reported: (1) a limited edition of the *Colour Index*, produced by photo-offset, to bridge the gap until the new edition is available; (2) a revised edition of "Identification of Dyes on Textile Fibers" by Clayton; (3) Symposium on Fibrous Proteins and (4) "The Theory and Practice of Wool Dyeing" by Bird. Good progress on compiling the new *Colour Index* in cooperation with the AATCC was indicated.

The Society's Medals were awarded as follows: H. H. Bowen (Gold Medal), Dr. H. H. Hodgson (Gold Medal), Mrs. P. Cummings (Silver Medal), Dr. E. Race (Silver Medal) and H. Turner (Silver Medal).

The following officers were elected: *President*—C. M. Whittaker; *Vice-Presidents*—Dr. H. A. Thomas, D. B. F. McAndrew, H. Foster and G. M. Williams; *Members of Council*—F. Scholefield, Dr. P. W. Cunliffe, R. J. Hannay, G. E. Holden and J. G. Evans; *Honorary Treasurer*—H. Jennison; *Honorary Secretary*—J. Baritt.

A report of the Annual Dinner followed the above.

A Theoretical Discussion of Further Substitution in Disubstituted Naphthalenes. Part III—The Further Nitration of the Dinitronaphthalenes

H. H. Hodson and E. R. Ward, Journal of the Society of Dyers and Colourists, page 141, Vol. 63, No. 5, May, 1947.

This paper is summarized as follows:

The mono- and di-nitrations of the 1:3-, 1:4-, 1:5-, 1:6-, 1:8-. 2:6- and 2:7-dinitronaphthalenes are discussed from the standpoint of the Vesely and Jakes quinonoid hypothesis of naphthalene substitution as modified by modern electronic and resonance theory. Further the readier nitration of β- compared with α-nitronaphthalenes, the facile dinitration of 2:6- and the difficulty of mononitration of 2:7-dinitronaphthalene, and also the ease of step-wise nitration of the other dinitronaphthalenes, are explained on the above theory.

Wool Raw Stock Processed in Modernized Dyehouse

M. H. Hudson, Textile World, page 112, Vol. 97, No. 5, May, 1947.

A report on the modernization of the dyehouse at the Atlanta Woolen Mills, Atlanta, Ga., which was started in the spring of 1946.

The Re-Dyeing of Faded Woollen Garments

G. G. Simpson, Journal of the Society of Dyers and Colourists, page 171, Vol. 63, No. 6, June, 1947.

Six standard fades were prepared by exposure under glass together with sets of the Society of Dyers and Colourists light fastness standards as a check on the degree of exposure. These standards were used in experiments using both the one-bath union method and the two-bath method.

It was found that better covering of faded wool in the presence of cellulose was obtained with the one-bath union method, when using properly selected dyes, than by the two-bath method or by the use of mixtures of neutral dyeing acid dyes and wool-reserve direct cotton dyes. Alkalies and high temperatures affect the faded areas adversely.

The fade absorbs more dye initially than the unfaded portions due to the increased swelling properties of the faded fibers. As dyeing proceeds, the fade tends to lose dye in favor of the normal wool. The choice of dyes for covering faded woolen garments has been found to be closely connected with the chemical constitution of the dyes and their basicity. By taking the basicity of the dyes as a starting point, a satisfactory selection of dyes is possible.

Textiles from Seaweed

G. Fitzgerald Lee, Textile Mercury and Argus, page 945, Vol. CXVI, No. 3039, July 4, 1947.

Up to the present time the principal uses of alginate, a continuous filament yarn produced from a seaweed base, have been as supporting threads for fine textiles and for the easy production of intricate lace. The present article suggests that alginate yarns, properly developed, are capable of yielding all-alginate fibers equal to the best rayons.

Effect of Light on Colours and Fabrics

"Colourist", The Textile Manufacturer, page 278, Vol. 73, No. 870, June, 1947.

Beyond the visible spectrum there lie, at either end, the ultra-violet and the infra-red rays, which both influence fading and tendering in varying degrees. The intensity of light decreases in proportion to the square of its distance from the source. Humid atmospheres produce large increases in fading.

The action of air on wool fibers in the natural state has the effect of bringing about structural changes which later on affect the dyeing and finishing properties. Long exposure brings about the formation of sulfuric acid in wool fiber by photo-chemical oxidation of the cystine content of the wool molecule.

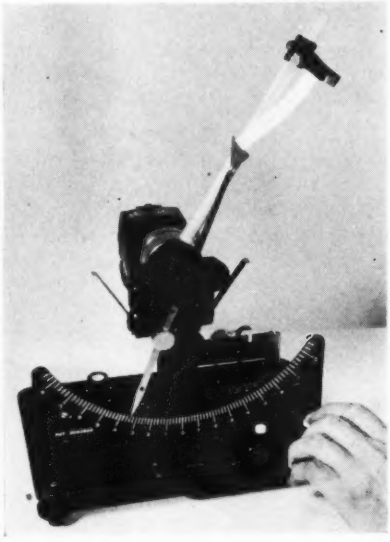
The effect of light on cellulose has been demonstrated in the tendering of long-exposed fabrics, the cellulose being gradually converted to oxy-cellulose.

The effect of light is most noticeable in dyeing where the dyeing materials are actually in a state of chemical change. The leuco esters of vat dyes are also very sensitive to the action of sunlight. In printing, the exposure of the damp surfaces of the prints to sunlight may produce subsequent unlevel development. The adverse action of light may be noted in a good many instances even when the goods have reached the finished stage.

TRADE NOTES • NEW PRODUCTS

• New Stiffness Tester

A new motor-driven stiffness tester, desinged for rapid, consistent and accurate tests on textiles has been developed by W. & L. E. Gurley of Troy, New York. The tester is said to measure the stiffness, or absence of it, of practically any thin flexible material, and it can also be used for testing coated fabrics.



Gurley Stiffness Tester

The Gurley stiffness tester has a balance pointer which pivots in jewel bearings, and moves parallel to a sine scale mounted on the base. It is loaded below the center with weights of 5, 25, 50, or 200 grams, fastened 1, 2, or 4 inches from the pivots. The arm carrying the sample being tested is moved by a small-geared synchronous motor which is controlled by a reversing switch on the base.

Bulletin No. 1440 containing complete details of the new motor-operated stiffness tester is available on request to W. & L. E. Gurley, Troy, New York.

• Textile Institute Journal Again Available

The Textile Institute, 16 St. Mary's Parsonage, Manchester 3, England, announces that it is now in a position to again accept subscriptions for its Journal for distribution in the United States. The subscrption rate is £3/10/0 per year. The Textile Institute is an international organization of textile technologists which was founded in 1910 and granted a Royal Charter in 1925.

• New York Manager, Monsanto Textile Chemicals

Robert S. Dempsey, who has been appointed New York Manager of Sales and Development of the Textile Chemical Department of Monsanto Chemical Company. He will be located at Monsanto's new offices in New York City at 445 Park Avenue.

Mr. Dempsey, until recently vice-president of the Raycrest Mills of Pawtucket, Rhode Island, has spent more than 20 years in the textile industry. For 17 years prior to the war he was asociated with McCampbell & Co. and for a decade headed their converting department. He was a pioneer in the introduction of shrinkage control processes for cotton goods and in vat dyeing piece goods for the work clothing field.

During the war Mr. Dempsey was chief of the Textile Machinery Branch of the War Production Board.

• Department Head, N. C. State

Henry A. Rutherford has resigned his position as an official of the National Cotton Council of America to become head of the Textile Chemistry and Dyeing Department of the School of Textiles at N. C. State College, Dean Malcolm E. Campbell announced recently.

Prof. Rutherford will replace Prof. A. H. Grimshaw, who asked to be relieved of the duties because of his health. Professor Grimshaw, who has been a member of the college faculty for many years, will continue, however, as a professor in the School of Textiles.

Professor Rutherford will continue to collaborate with the National Cotton Council in its future activities.

In addition to his connection with the National Council, Prof. Rutherford was associated with the National Bureau of Standards on Research Associateships sponsored by the American Association of Textile Chemists and Colorists and the Textile Foundation from May, 1936, to January, 1945. In that capacity, his work consisted in fundamental chemical research on the natural textile fibers of cotton, wool and silk.

During 1943 and 1944, he acted as assistant to Dr. Milton Harris, director of research for the Textile Foundation group, and in January, 1945, he became affiliated with Milton Harris Associates, consultants to the textile and allied industries, as assistant director of research.

• Books on German Reports Available

Mapleton House, Publishers, 5415 17th Avenue, Brooklyn 4, N. Y., announces the availability of the following books dealing with the German textile industry:

Textile Machinery—by H. Charlesworth and Associates. High speed winding, sizing, dyeing and carbonizing machinery; processing of yarn; finishing machinery; accessories; shuttle block industry; loom making; punching of spinnerets, $8.00.

German Cotton, Rayon and Silk Industries—by D. W. Hill and Associates. New developments in the field of spinning, weaving, printing, dyeing and finishing. $5.00.

German Rayon and Staple Fiber Industry and Allied Engineering Industry—by A. G. Williams. New processes and equipment. $4.00.

Textile Auxiliary Products—by W. Baird. I. G. reports on the development work on the Reed reaction to produce Mersol 'H' and on a new reaction to give alkylsulfonic acids by catalyzed reaction of paraffins with sulfur dioxide and oxygen. $3.00.

Study of Wool Substitute Fabrics—A report of studies made by order of the Quartermaster Board, Camp Lee, Va. $2.00.

A catalog of books available may be obtained on request to the publishers.

• Amioca Available

Amioca, the only commercial starch composed of 100 per cent amyloypectin, is again available in large quantities, according to National Starch Products Inc., 270 Madison Avenue, New York.

In the textile field, Amioca or its modifications are said to provide sizings with adhesive, non-jelling and film-forming properties and excellent rinsability, as well as textile finishes with clear, glossy films and resistance to iron-browning. For grease-proof tub sizings, the non-jelling characteristics of the domestic starch are said to permit high solids application.

• Commodity Standards Division

The consolidation of two divisions of the National Bureau of Standards—Commercial Standards and Simplified Practice—into a single division called Commodity Standards has been announced by Dr. E. U. Condon, Director of the Bureau.

The new Commodity Standards Division will continue the Bureau's coordinating role in the development of voluntary simplified practice recommendations and commercial standards with industrial and technical groups. In addition, the division will be responsible for coordinating Bureau work for the Federal Specifications Board. Edwin W. Ely, former chief of the Simplified Practice Divisions has been appointed as chief of the division and F. W. Reynolds, former acting chief of Commercial Standards, as assistant chief.

• General Manager, Lawrence Print Works

A. C. Holdsworth has been named general manager of the Lawrence Print Works, Inc., at Lawrence, Mass. Well known in the textile finishing industry, Mr. Holdsworth comes to Lawrence from the vice presidency of the Providence (R. I.) Dyeing, Bleaching and Calendering Company. Previously he was plant manager of the Bradford Dyeing Association (U. S. A.), of Bradford, Rhode Island.

Raymond E. Caffray, former vice president and general manager of the Lawrence plant, now on an extended vacation due to poor health, will return to the company as a sales executive in the New York office at 271 Church Street.

• Suction-Type Dryer

A new suction-type cylinder dryer is now available which is said to save time in finishing a variety of textile fabrics while providing precision control of quality. The dryer was developed jointly by the American Viscose Corporation's Textile Research Department at Marcus Hook, Pa., and Proctor and Schwartz, Inc.

In some cases the machine is said to reduce drying time from thirty minutes to five. One man can operate it. He can instantly stop and reverse it if he discovers defects in goods about to enter the dryer, and thus prevent them from becoming permanently set in the finish.

The fabric enters the machine from a spreading device and is then fed onto a scrim-covered, perforated, revolving cylinder. A continuous cover-belt of very open mesh holds the fabric in position.

Blowers force air, previously heated to desired conditions through the cover-belt, fabric and cylinder. Disks adjustable to fabric width confine this air flow solely to the area covered by the fabric. Its high velocity holds the fabric firmly against the cylinder without stretch, strain or change in width.

It is claimed that the new dryer has been thoroughly proved in practical service on tricot, circular knit and open-width woven fabrics, on resin finishing, rayon and silk prints, and others.

• Joins Procter & Gamble

Arthur S. Davis who has recently joined the staff of The Procter & Gamble Company, in the Textile Research Department of the Chemical Division. Prior to joining Procter & Gamble, Mr. Davis was Quality Engineer of the Barbour Mills, of Brockton, Massachusetts. He has served in various executive technical capacities with Calco Chemical Co., F. C. Huyck & Sons, U. S. Testing Co., and Ciba Co., Inc.

In November 1945, Mr. Davis was released to inactive duty as a Lieutenant of the U. S. Navy following 43 months' service with the Air Branch of the Atlantic Fleet. He received his Bachelor of Textile Chemistry degree at Lowell Textile Institute in 1940. He is a member of the Tau Epsilon Sigma, the Textile Scholastic Society, and the AATCC.

• du Pont Appointments

Elgin S. Nickerson has been appointed general manager of the Fabrics and Finishes Department of E. I. du Pont de Nemours and Company. Mr. Nickerson, who was assistant general manager of the department, succeeds J. Warren Kinsman, who recently became a vice-presdent and member of the company's Executive Committee.

These other management changes also were made, effective August 1:

Dr. H. H. Hopkins, formerly manager of the Finishes Division, was appointed assistant general manager of the Fabrics and Finishes Department, succeeding Mr. Nickerson.

Matt Denning, formerly assistant manager of the Finishes Division, was designated manager, succeeding Dr. Hopkins.

M. A. Dibble, formerly assistant director of production of the Finishes Division, was appointed assistant manager of the department, succeeding Mr. Denning.

• Appointed to IRI Staff

Oliver G. Edwards, formerly director of research for the Avondale Mills, Sylacauga, Alabama, has accepted an appointment to the staff of the Industrial Research Institute of the University of Chattanooga where he will investigate problems for the textile industry.

During the past twelve months, Mr. Edwards was in Germany as a member of the Quadripartite Commission on Textiles, which set the industrial level for postwar Germany.

• Booklet on Hydrogenation

A new booklet on Hydrogenation has been published by the Hooker Electrochemical Company, Niagara Falls, N. Y.

This Bulletin No. 8, discusses the research and developmental work that Hooker is prepared to do, the facilities for both high pressure and low pressure hydrogenation, the types of hydrogenation reactions Hooker is doing, and the technical service available.

Copies of the Bulletin are available upon request.

• Carbide & Carbon Booklet

A new and revised edition of the booklet, "Physical Properties of Synthetic Organic Chemicals," has just been issued by Carbide and Carbon Chemicals Corporation, a Unit of Union Carbide and Carbon Corporation. This 12-page booklet has been designed as a condensed guide for users of organic chemicals. It contains data on applications and physical properties for more than 175 synthetic organic chemicals. The material is presented in tabular form for ready and easy reference. Copies may be obtained without charge by writing to Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York 17, N. Y. Ask for Form 6136.

• Goal Passed in NETF Campaign

George T. Metcalf, Executive Secretary, announced recently that the $250,000 goal for the 1946-47 campaign of the New England Textile Foundation, 68 South Main Street, Providence, R. I., had been passed. 301 donors contributed a total of $251,105, or an average of $834 each.

This brings to a successful close the first of four annual campaigns to raise $250,000 per year, or a total of $1,000,000. Similar campaigns are planned for the next three years. The money so obtained will be used by the NETF to assist New England textile schools and to grant scholarships to deserving students who wish to attend them.

The schools are Lowell Textile Institute at Lowell, Mass., the Textile School of the Rhode Island School of Design at Providence, R. I., the Bradford-Durfee Technical Institute at Fall River, Mass., and the New Bedford Textile Institute at New Bedford, Mass. The NETF fund (principal as well as interest) will be used to increase teacher salaries at these schools in order to attract the best available teachers, to modernize or replace antiquated or inadequate school equipment and facilities, and to grant as many scholarships as possible annually to the most deserving students who apply.

• Publications of SDC

The Society of Dyers and Colourists, 32-34 Piccadilly, Bradford, Yorkshire, England, announces the availability of the following publications:

Fibrous Proteins—Natural and Synthetic. Forword by Sir Edward Appleton, K.C.B., M.A., D. Sc., F.R.S. The bound volume of the papers and discussions given at the symposium on fibrous proteins, held at Leeds University in 1946, to which distinguished British and foreign scientists contributed, for the first time, many of the results of war-time research. Price 27/6 post free in U.K.

Identification of Dyes on Textile Fibers and Detection of Metals in Fibrous Materials, Dyes and Organic Pigments. By Ellis Clayton, F.R.I.C. Second Edition—Revised and Enlarged (1946). Price 10/6 post free in U.K.

Report of the Fastness Tests Committee of the Society on Standards for Light, Perspiration and Washing. (1934). Price 7/6 post free in U.K.

Reprint of 1924 Colour Index. Contents: Synthetic Organic Dyestuffs; Natural Organic Dyestuffs; Natural and Artificial Inorganic Coloring Matters; General Indices (including Patent Numbers, Intermediate Products; Applications, other than Dyeing Textile Fibers, of Synthetic Organic Dyestuffs; Commercial Names of Coloring Matters). Price £5/15/- post free in U.K.

Reprint of 1928 Supplement to the Colour Index. Price £1/-/-post free in U. K.

Journal of the Society of Dyers and Colourists. This journal, which has been published monthly since 1884, is of interest to dye and color chemists and physicists, research workers, students, teachers and makers and users in the dyeing and coloring industries generally. Editor—C. L. Bird, M.Sc. F.R.I.C. Annual subscription 60/- post free.

The Jubilee Issue of the Journal of the Society. This unique volume, published in 1934, consisting of 239 pages, with numerous illustrations, and well bound, is a remarkable record of achievement in the dyeing and allied industries, from both the scientific and technical aspects, and contains a series of articles by eminent authorities. Price 25/- post free in U.K. (Members 12/6; Junior Members 5/-).

Theory and Practice of Wool Dyeing. By C. L. Bird, M.Sc. F.R.I.C., Lecturer in Dyeing at the University of Leeds, and Editor of the Journal of the Society. Price 12/6 post free in U.K.

• Joins Hart Products Sales Staff

Mrs. Helen Gilligan Buchanan, Broadway musical comedy star of a few years ago, who has joined the New England sales staff of the Hart Products Corporation, textile chemical manufacturers. Mrs. Buchanan is the wife of the late Raymond Buchanan, former salesman for Hart Products, and has assumed his sales position since his untimely death, May 7th, 1947.

Under her maiden name of Helen Gilligan, Mrs. Buchanan had leading roles in such Broadway successes as "Hold Everything," "Greenwich Village Follies," "Strike Up the Band" and Noel Coward's "Private Lives."

Mrs. Buchanan makes her home in Stafford Springs, Conn., and is the mother of two children, Claire, 14, and Jimmy, 11. She will handle the sales for Hart Products throughout the state of Connecticut.

• ASTM Annual Meeting

The 1947 Annual Meeting of the American Society for Testing Materials, the fiftieth held by this national group since the first one in Philadelphia in 1898, focused attention on a number of important activities involving standardization and research in materials. Throughout the week of the meeting in Atlantic City beginning June 16 there were about 350 meetings of the Society's technical committees and of the nineteen technical sessions scheduled at which many papers and reports were presented five were formal symposiums with collections of papers on specific topics, including load tests of bearing capacity of soils, measurement of entrained air in concrete, synthetic lubricants, insulating oils, and rubber testing.

The total registered attendance at the meeting was 1781 compared with the previous high in New York in 1944 of 2063, and Buffalo in 1946 of 1835.

As a result of recommendations by the technical committees the Society approved 43 new tentative specifications and tests and 70 previously published tentatives are to be adopted as formal standards. Standards recommendations were pretty well divided throughout the Society's field of work, although the Steel Committee, as a result of intensive activity during the week, reported seven new specifications.

The twenty-first Edgar Marburg Lecture featured the subject "Engineering Laminates" and was presented by Professor W. C. Voss, Head, Department of Building Engineering and Construction, Massachusetts Institute of Technology.

Two awards were made at the meeting, the Sanford E. Thompson Award recognizing an outstanding paper on concrete and concrete aggregates being given to William Lerch, Manager, Applied Research, Portland Cement Association. His paper presented in 1946 covered "The Influence of Gypsum on the Hydration and Properties of Portland Cement Pastes." The other award, the Richard L. Templin Award which recognizes meritorious contributions describing new testing methods and apparatus, was presented to F. B. Quinlan, Metallurgical Section, Works Laboratory, General Electric Co., Schenectady, N. Y., for his paper on "Pneumatic Fatigue Machines" part of the Symposium on Parts and Assemblies held at the 1946 Annual Meeting.

In the annual President's Address, given by Arthur W. Carpenter, Manager of Testing Laboratories, The B. F. Goodrich

Co., Akron, Ohio on the subject "Our Stake in Materials Progress" it was pointed out that while this was the Fiftieth Annual Meeting since the Society first started sessions in 1898, it was not officially incorporated as a national technical Society until 1902.

Mr. Carpenter pointed out the ASTM standards have been widely accepted, they are a part of building and other types of codes throughout the country, and they are the basis of business transactions representing a considerable bulk of the manufactured products of the nation, and further stressed the fact that the Society must be alert in maintaining the quality of its standards, new ones must be set up where desirable, and be ready when needed. In closing he emphasized the necessity of stimulating research work, pointing out that ASTM always has a great deal of cooperative testing and evaluation under way in its technical committees.

T. A. Boyd, Head, Fuel Department, Research Laboratories Division, General Motors Corp., Detroit, Mich., was elected President for 1947-1948, succeeding Mr. Carpenter, who continues on the Board of Directors as Past-President for three years. J. G. Morrow, Metallurgical Engineer, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada, is the new Vice-President to serve with the Senior Vice-President R. L. Templin, Assistant Director of Research and Chief Engineer of Tests, Aluminum Company of America, New Kensington, Pa. The new members of the Board of Directors are as follows:

T. S. Fuller, Engineer in Charge of Works Laboratory, General Electric Co., Schenectady, N. Y.; Everett G. Ham, Technical Director, John A. Manning Paper Co., Inc., Troy, N. Y.; J. J. Laudig, Research Engineer, Delaware, Lackawanna & Western Railroad Co., Scranton, Pa.; H. L. Maxwell, Metallurgist, E. I. duPont de Nemours & Co., Inc., Wilmington, Del.; and Louis J. Trostel, Chief Chemist, General Refractories Co. Laboratories, Baltimore, Md.

Gerald C. MacDonald, Manager, Quality Control Group, Montgomery Ward and Co., Chicago, Ill., has been appointed to the Board of Directors to fill an unexpired term. His term will carry through 1949.

Three engineering leaders, long-time and active members of the Society, and each a past-president were awarded honorary membership. They are as follows: F. Malcolm Farmer, Vice-President and Consulting Engineer, Electrical Testing Laboratories, Inc., New York, N. Y.; Arno C. Fieldner, Chief, Fuels and Explosives Services, U. S. Bureau of Mines, Washington, D. C.; H. S. Vasser, Laboratory Engineer, Public Service Electric and Gas Co., Testing Laboratory, Maplewood, N. J.

It was announced that the 1948 Annual Meeting of the Society will be held in Detroit during the week of June 21-25 and in conjunction with this will be the Eighth Exhibit of Testing Apparatus and Related Equipment. Several Detroit hotels will cooperate, but headquarters will be at the Book-Cadillac. The 1948 Committee Week and Spring Meeting will be held in Washington during the week of March 1-5. In addition, a number of ASTM technical committees will either hold group sessions separately or may combine with other committees in the same fields for three or four-day meetings in the fall or spring. While official announcement has not yet been made, it is quite definite that the 1949 Annual Meeting will be in Atlantic City, with the likelihood that Committee Week and Spring Meeting for that year will be in Chicago during the week of February 28-March 4.

• Professor of Synthetic Fibers

Harry B. Garden, a native of Macon, Ga., has been appointed professor of synthetic fibers and becomes the first man to fill the Burlington Mills professorship in the School of Textiles at N. C. State College, Dean Malcolm E. Campbell announced recently.

The professorship was made possible last year by a contribution of $65,000 by the Burlington Mills to the North Caroline Textile Foundation.

Dean Campbell announced that Prof. Garden, who has already joined the college faculty, is now setting up synthetic fiber courses, including synthetic fiber quality, rayon preparation, rayon throwing and associated processes, and fabric identification.

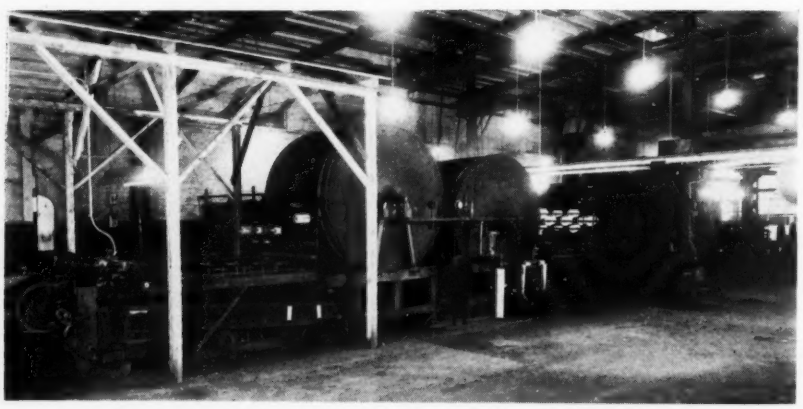
In addition to the processing phases, the program will include the blending of the fibers together with wool and cotton, Dean Campbell said.

• Acquire Rights to Batchelder Machine

United Steel of America, Inc., 30 Rockefeller Plaza, New York 20, N. Y., announces that they have acquired the manufacturing and sales rights to the Batchelder patent machine for yarn dyeing, sizing and beaming.

The machine operates continuously, drawing yarn from the warp beams and assembles the drawn off yarns to form a sheet or ribbon. This ribbon of yarn is continuously power fed through a series of dye and treatment vats in a substantially tensionless condition and thence fed over drying cylinders through a size box and over slasher cylinders and wound on loom beams. The dyes, water, etc., are continuously fed into the dye range at a predetermined rate.

Reports are said to indicate the dyeing and slashing labor and dyeing materials cost per pound of yarn processed on this continuous machine is about 30% less than when the yarn is raw stock dyed. The machine is said to operate with a minimum of attention, has very little yarn breakage and produces dyed and sized yarn very uniform in color.



An Installation of the Batchelder Patent Machine at Empire Cotton Mills, a Division of the Woods Manufacturing Co., Ltd., Welland, Ontario, Canada.

This view is from the head end of the slasher back to the warp beams at the extreme right end.

This machine was assembled in 1940 as an experiment but, it is claimed, has been operating steadily and successfully up to date. It will now be modernized by installing a new stainless steel dye range with either hydraulic or pneumatic squeeze rolls, stainless steel dryer and slasher cylinders and other improvements that, it is stated, will allow the machine to operate with all types of dyes and at a higher speed.

Proceedings of the

American Association of Textile Chemists and Colorists

Copyright, 1947, American Association of Textile Chemists and Colorists

August 25, 1947

Silver Anniversary, Philadelphia Section

THE Philadelphia Section plans to celebrate its Silver Anniversary in the form of a gala 25th Birthday Party to be held on Saturday evening, November 8th, in the Main Ballroom of the Bellevue Stratford Hotel in Philadelphia.

It is planned to have a cocktail hour preceding the dinner. The dinner will be highlighted by excellent entertainment and dancing to the music of a name band.

Fall Meeting, Piedmont Section

THE Fall Meeting of the Piedmont Section will be held at the Hotel Charlotte, Charlotte, N. C. on Saturday, October 4th. Members are urged to make their hotel reservations at once.

The report of the nominating committee will be presented and new officers will be installed. Further details will be mailed to members at an early date.

Meetings, New York Section

TWO meetings of the New York Section will be held during the balance of 1947. They will be held on September 26th and December 5th, both at the Swiss Chalet in Rochelle Park, New Jersey.

Section on Standard Soils

F. A. PRISLEY, of Watson Park Co. and chairman of the Committee on Detergency, has announced the formation of a new section which will investigate the problem of standard soils and their use. The Section on Standard Soils is headed by E. A. Vitalis, of American Cyanamid Co.

South Central Research Committee

J. ROBERT BONNAR, Chairman of the Executive Committee on Research, announces that the South Central Section has appointed an Advisory Research Committee. Members of this new committee are: Dr. Raymond Seymour, chairman, Chattanooga Industrial Research Institute; A. J. Kelly, Burkart-Schier Chemical Co.; J. A. Crumley, Bryan Full Fashioned; and William G. Agnew, Dixie Mercerizing Co.

CALENDAR

PHILADELPHIA SECTION
Meetings: September 26 (Kugler's, Philadelphia), November 8 (Silver Anniversary Meeting), January 16, 1948, February 27, April 9, May 21 (Bellevue-Stratford Hotel, Philadelphia).

NORTHERN NEW ENGLAND SECTION
Meetings: September 26, November 21.

SOUTH CENTRAL SECTION
Fall Outing, September 5 and 6 (Lookout Mountain Hotel).

PIEDMONT SECTION
Fall Meeting: October 4 (Hotel Charlotte, Charlotte, N. C.).

NEW YORK SECTION
Meetings: September 26, December 5 (Swiss Chalet, Rochelle Park, N. J.).

NATIONAL CONVENTION
October 23, 24, 25 (Congress Hotel, Chicago).

National Convention

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Chicago October 23, 24, 25

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Auspices of Mid-West Section

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Headquarters: Congress Hotel

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Watch future issues for more news of the Convention

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information from the Secretary.

47-30

Education: Graduate, Bradford Durfee Textile Institute.
Experience: Dye laboratory, executive management of dyeing and finishing, various threads, cotton goods, printing.
Age 38; married; references.

47-31

Education: B.Sc. & M.Sc., Philadelphia College of Pharmacy & Science.
Experience: Research chemist, Director of Research & Quality Control, surgical and textile goods.
Age 33; married; references.

47-32

Education: Textile Chemical Engineer, State College, Austria.
Experience: Dyeing and finishing on a variety of fibers and products with executive responsibility, development and sales promotion.
Age 31; married; references; New York City or West Coast preferred.

47-33

Education: Graduate vocational school, with additional college courses in chemistry.
Experience: Laboratory dyeing and testing; dyer of yarns and hosiery with executive responsibilities in dyehouse.
Age 31; married; will go anywhere in U. S.; New York area preferred because residence available.

47-34

Education: Columbia University, one year.
Experience: Laboratory asst., and operator of most machines in bleachery and dye house.
Age 35; married; references; prefers N. E. or N. Y.

47-35

Education: B.S. in Textile Chemistry, North Carolina State College, 1947.
Experience: Analytical chemist, construction and operation of water purification plants, pulp and paper manufacture including bleaching; Navy technician.
Age 25; single; references.

Questions Answered by Experts at Philadelphia Meeting

AT the meeting of the Philadelphia Section held on May 23rd at the Bellevue-Stratford Hotel in Philadelphia an Information Forum was conducted and a number of questions were submitted by the members and answered by experts who were on hand. A few of the questions and their answers follow.

Question: "What Methods Should Be Considered the Proper Ones for the Evaluation of Permanent Water-Repellent Finishes?"

Answered by George A. Slowinske, Fine Chemicals Division, Technical Laboratory, E. I. du Pont de Nemours & Co., Inc.

BEFORE attempting to answer the question, I am going to object to the term "permanent water-repellent finishes". There are no permanent water-repellent finishes on the market today. The term "durable" describes the type more accurately. And my definition of a durable water-repellent finish is one which gives serviceable performance throughout the normal life of the article to which it is applied. Such a definition makes allowance for the fact that laundering, drycleaning, or actual exposure and wear gradually decrease the effectiveness of the best water-repellent finishes available today.

The water-repellency test methods which should be used to evaluate durable finishes are exactly the same as those used for non-durable finishes. In the case of the durable finishes the tests should be applied before and after the exposure conditions or operations which tend to break the finishes down. For example, the tests should be applied before and after laundering.

Now the tests available can be, *and should be*, divided into two classes.

Class I

Tests which measure resistance to wetting of the fabric and its fibers.

Class II

Tests which measure resistance to the penetration of water or rain through the fabric.

The tests which fall into Class I are well suited to the evaluation of water repellents—both the durable and non-durable types. They measure the property which such agents impart to textiles—resistance to wetting of the fibers and yarns. They are influenced to only a minor degree by yarn or fabric construction. For that reason they are the ones which should be used by the finishing mill to evaluate the quality of its production. The most suitable test instruments are:

(1) The AATCC Spray Tester.
(2) The AATCC Immersion Absorption Tester.
(3) The Army Dynamic Absorption Tester.

I want to emphasize that those three laboratory instruments will not tell you whether or not rain will go through a fabric; they will simply tell you whether or not a good water repellent has been properly applied by the finishing mill.

The tests which fall into Class II are the ones which will predict whether or not rain will penetrate through a fabric. The Class II tests give results which are dependent on the water resistance imparted by the proofing agent and on the construction of the fabric. They are the ones which should be applied by you or me when we wish to evaluate the rain penetration resistance of one treated fabric against another treated fabric of the same or different construction. Consequently, they are the ones which the converter or garment manufacturer might apply to test the rain resistance of the treated fabric which reaches him. The most readily available test instruments are:

(1) The AATCC Impact Penetration Tester.
(2) The AATCC Hydrostatic Pressure Tester.
(3) The Drop-Penetration Tester used by the Army.
(4) The recently adopted AATCC Rain Tester.

Of those four instruments I believe the Rain Tester is the best. For further information on the Rain Tester, look up the March 10 issue of this year's American Dyestuff Reporter. For a good general summary of the whole water repellency problem as it exists today, I would refer you to the article by Rowen and Gagliardi of the Bureau of Standards, which appeared in the January, 1947 issue of the Journal of Research of the National Bureau of Standards.

The question of fastness procedures is a complex one, which always comes up in discussing durable water repellents. There are in use today a considerable number of laundering procedures, drycleaning procedures, and wear tests. They differ widely in severity. What the most proper ones are is difficult to decide. However, we have two leads. During the war the Army purchased hundreds of millions of yards of durable repellent treated fabric which met certain minimum repellency standards after specified laundering and drycleaning operations. For the last 8 years, the Du Pont Company has controlled the fastness of "Zelan" durable repellent finishes on fabrics by the use of minimum repellency requirements after specified laundering and drycleaning operations. It has been found in general that a durable repellent treatment which can meet the Army specifications and the similar Du Pont specifications will give good service during actual use.

Question: "What Should Be Considered the Proper Condition of Waste Liquor from a Finishing Plant When Entering Streams in Pennsylvania? What Type of Treatment Will Produce this Condition of Waste Liquor?"

Answered by F. B. Milligan, Industrial Wastes Engineer, Department of Health, Commonwealth of Pennsylvania.

IT would be a simple matter to answer the first of these questions by reciting the provisions of Pennsylvania's stream pollution laws—Act No. 394 of the General Assembly, approved June 22, 1937 (P.L. 1987) as amended by Act. No. 177 approved May 8, 1945 (P.L. 435). The amendments have to do chiefly with colliery wastes, although there are also some changes in penalties and legal procedure.

According to these laws (Section 302 of Act 394 as amended) "*** any discharge that is inimical and injurious to the public health or to animal or aquatic life, or to the use of the water for domestic or industrial consumption or recreational purposes, shall *** be deemed unlawful and a nuisance ***".

The Sanitary Water Board is engaged in a comprehensive program for stream protection and improvement. In respect to industries discharging polluting wastes, the board requires treatment capable of effecting reduction in their pollution characteristics equivalent to the primary or the complete treatment of municipal sewage, depending upon the location of the plant.

In respect to the "complete" treatment of sewage, the Board requires a reduction of at least 85% in the polluting characteristics of the sewage as measured by the 5-day biochemical oxygen demand test, and the practically complete removal of *suspended* solids, color, oils, greases, acids, alkalis, and toxic, putrescible, taste and odor-producing and other substances inimical to the public interest in the receiving stream. An equivalent degree of treatment is required for industrial wastes in similar drainage areas.

The requirements for "primary" treatment of sewage are the reduction by at least 35% of the organic pollution load as measured by the 5-day B.O.D.; the practically complete removal of *settleable* solids and the production of an effluent which in all other respects will meet the requirements set forth above for "complete" treatment, with an equivalent degree of treatment required for industrial wastes.

The words "at least" as applied to percentages of B.O.D. reduction, such as 85% for cases of "complete" treatment, mean that in most cases this reduction is expected to prove satisfactory but that, because of the condition of the stream or for some other reason (by actual test or by advance estimate), additional treatment may be required. All distilleries, for example, must reduce the B.O.D. of their wastes by 95% and in one case now pending, an even greater improvement will be required because of the small size of the receiving stream. Every permit as issued contains the provision that additional treatment must be added if, in the judgment of the Board, this should prove necessary. Some concerns have wished to receive a flat permit analogous to a building permit, good once and for all, until they have come to realize that in such a case the Board would have to require treatment works far oversized to take care of the worst possible condition of wastes, overloads, low stream flows, and other contingencies—and that even then, if the establishment were to increase in size, additional capacity would have to be provided. With the "more if necessary" clause, however, the works may be designed much closer to the estimated requirements and additions made later if necessary.

The present policy of the Board divides the streams on the basis of their use, condition and assimilating power in accordance with which a flat percentage of reduction as measured by the 5-day B.O.D. is required of all discharges to a given stream with additional treatment if actual conditions indicate the need thereof.

Several large industries, notably the milk industry as represented by the Pennsylvania Milk Dealers' Association, have formed committees of engineers and technical men to meet with the engineers of the Sanitary Water Board in order to formulate or establish characteristics attributable to "normal" raw wastes, that is, the wastes produced by an ordinarily well-operated plant of a given type. In the milk industry there are milk receiving stations, plants for evaporating whole milk, cheese manufacturing plants, etc. In many instances several of these processes are carried on under one roof. Therefore, by establishing normal raw wastes from each type of plant and applying such characteristics proportionately on the basis of the quantities of raw milk processed in each manner at a given establishment, it becomes possible to evaluate quite fairly the normal raw waste which should be produced by such a plant.

The recommendations of the committee relative to normal raw wastes from milk plants of various types are now in the hands of the Sanitary Water Board for its consideration. To the finally accepted values will be applied the Board's requirements for "complete" or "primary" treatment.

This procedure makes it possible for a plant to determine how far it will be economically advantageous to go in good housekeeping prior to waste treatment. The dairy industry's committee has prepared memoranda covering recommended methods of good housekeeping, which are being distributed to the association's members.

Similar steps are being taken by the pulp and paper industry and long ago were put into practical effect by the tanners. It is strongly urged that the textile industry consider the prompt formation of a committee analogous to that of the milk industry as described above, and arrange to meet with the engineers of the Board so that the preparation of normal raw waste standards for the various principal types of textile mills may be considered. If these are not determined, the percentage reduction may bear more heavily upon an industrial plant already practicing "good housekeeping" (with a somewhat reduced pollution load in consequence) versus a poorly operated plant where ordinary attention to water conservation and neat operation might go far toward meeting the initial requirements on a percentage basis. It is true that in the end, since the actual effect on the receiving stream will be studied, the poorly kept plant in the average case will have to put in larger and more expensive waste treatment works.

Prior to the construction or operation of any works for the treatment of industrial wastes in Pennsylvania, the law requires that a permit be obtained from the Sanitary Water Board. The application must be made on forms supplied by the Board, must be accompanied by detailed engineering plans, and an engineering report descriptive of these works and of the quality and quantity of the waste waters to be treated and of the effectiveness of the proposed treatment, together with other pertinent information. These plans and this report are required by law to bear the seal and signature of a registered professional engineer legally qualified to practice in Pennsylvania.

Referring once again to the determination of values for "normal" raw wastes from textile mills, it should be understood by the industry that comparatively little data are available for Pennsylvania establishments. In order to determine suitable values, a well-organized program of waste volume measurement, sampling and analysis would have to be instituted and carried forward for each type of textile mill. This would be the first and most urgent of the tasks of any committee or group formed to assist the industry in handling its waste disposal problems.

In respect to the second part of the question asked above, namely, "What type of treatment will produce this condition of waste liquor?", only a brief reference is possible since any proper discussion of this question would involve a treatise on textile waste disposal.

There is an increasing use of solvent recovery processes in wool scouring with consequent reduction in the load which must be handled by the waste treatment works. For the reduction of color, and the pollution load of dye wastes as measured by the 5-day biochemical oxygen demand test, a recirculating biological filter followed by final chlorination is claimed to be preferable—in practicability, simplicity of operation and ultimate cost—to chemical coagulation. The latter accomplishes no better decolorization as a rule, and less B.O.D. reduction, but does not require constant technical supervision, without which the results are worse than

useless, and with which they often are insufficient, especially where complete treatment is required. If sewage from the plant is treated with the plant's wastes in order to seed the filter at all times, the biological filter should give a more flexible unit with less careful supervision than the straight chemical treatment plant. Sedimentation, of course, is required in both cases.

Question: "What Are the Essential Requirements of a Good Textile Size for Rayon and Synthetic Yarn Warps?"

Answered by Carl Schlatter, Chemical Research Laboratory, American Viscose Corp.

BEFORE answering the question let's first look into the terminology. Synthetic yarns include the truly synthetics such as nylon, glass, "Vinyon", "Saran" etc.; then Aralac and other protein fibers, regenerated cellulosic yarns, cellulose acetate yarns, "Fortesan" and some of the lesser known ones. Naturally, it is not possible in the allotted time to go into the detail requirements for each and all of these different fibers, and the subject has therefore to be treated in a general fashion.

The primary requirements can be stated as follows: The size must impart cohesion to insure satisfactory loom operation and good fabric mechanical quality. All the other requirements discussed below are really secondary in importance.

(1) Among the secondary requirements, the point of cost should probably be listed at the top. Even if a size should give a hundred percent loom efficiency and perfect fabric there is still a limitation as to the price that the mill man can afford to pay for it. In calculating the cost of various sizes one must not only take into consideration the cost of the material or the cost of the gallon of sizing solution, but also the overall cost of hundred yards slashed with the various sizes.

(2) The next requirement is ease of preparation, the ideal size being one in which the ingredients are simply stirred into the water of the right temperature.

(3) Another requirement is the ease and uniformity of application. It should be possible to apply the size on a conventional slasher and the application should be uniform and the yarns well penetrated. This requires the size to have a low surface tension which insures quick wetting, and this point will be discussed again under formulations.

(4) Brittleness versus flexibility; a good warp size must not be brittle. This statement refers to the compounded formula. That is to say, if the size is left to dry on a glass plate, for instance, it must not result in a brittle film. As the warp yarns pass through the drop wires, the heddles and the reed they are rubbed and crushed and a brittle size will tend to dust off. Dusting then will result in sticky reeds, dirty looms and defective fabrics. This point also will be discussed again under formulations.

(5) A film obtained on drying of a successful warp size must have a certain toughness again to protect the warp yarn from the mechanical abuse of the moving loom parts.

(6) A very important requirement of the size is that it must have adhesion to the basic filaments and fibers. With rayon of regenerated cellulose this is no problem and most sizes, being applied from aqueous emulsion or solution, will adhere firmly enough. With acetate rayon fibers, this is not quite true and the ingredients of a formulation have to be chosen carefully to obtain a firm bond between the size and the filaments. The problem of adhesion is even much more difficult to solve for nylon, "Vinyon", glass and Saran fibers, and those who have worked on the problem of warp sizes for these yarns will all agree that this is one of the most difficult requirements to meet. To obtain this adhesion some formulators use plasticizers. This, however, is a delicate and even risky procedure because a little too much plasticizing action will have adverse effects on tensile properties and extensibilities.

(7) On the conventional slasher the warps are dried on cans made of tin plated metal or stainless steel and it is essential that the formulation be compounded in such a way as to minimize any sticking of the size and yarn to the cans.

(8) A further important requirement of a good size is that it be easily removable. Its complete removal should be possible through the use of a lukewarm bath as practiced in a scouring operation. While in years past, it was the practice to have a specific scouring operation, dyers have shortened their process in connection with certain types of goods and have been combining scouring and dyeing. This procedure demands that the size removal be practically instantaneous, for failure to come off during the early stage of the process would interfere with the fabric's ultimate dyeing uniformity.

The rapid and modern methods used by American dyers are setting extremely strict requirements as to the point of size removability—this, in contrast to the slower and less exacting approach followed by European dyers who at this time are still able to struggle with linseed oil base sizes which are tabooed here. European dyers can deal with such type sizes because of the greater amount of hand work and time allowed in their process and of the lesser consideration granted to the economical angle.

Formulation of Sizes

The formulations of warp sizes mostly contain two types of components. There may be more than two ingredients, however; they can generally be classed into two types, namely, film former and softener.

Among film formers are found gelatins, glues, converted starches, gums, alginates, polyvinyl alcohols, carboxy methyl cellulose, "Sylsize", resins, "Stymer", proteins and other lesser knowns. Aqueous solutions of all these materials dry to leave a film. During the drying all of these materials pass a sticky stage.

The other type of the component, the softener, has several functions. It acts as an interleafing agent to soften the film and to reduce its stickiness during the drying. The amount of softener that is needed depends very much on the type of film former that is being used. Gelatin and glue, for instance, make very brittle films and therefore they require definitely more softener or placticizer than polyvinyl alcohols, "Sylsize" and others. The softener must also act as a wetting agent to aid satisfactory penetration of the warp size into the yarn. In the earlier days the softeners were soaps, sulfonated fatty products, and sulfonated oils. They are invariably polar materials which are surface active, hence, act to various degrees as interleafing agents, softeners and wetting agents. Today we have a great number of surface active compounds available, as synthetic materials or semi-synthetic materials. Some of these products are much more powerful and specific in their action than soap, and to enumerate those found on the market would be so time-consuming that I prefer to refer you to the voluminous compilations which are being published every year by several agencies.

Hygroscopic ingredients. Some people feel that a warp size should contain a hygroscopic ingredient. Hygroscopic ingredients have their advantages in mills which are not air-conditioned, but they have their definite drawbacks. In case a warp is stored for considerable time in a moist atmosphere the outside will definitely be affected and variable results may be obtained. It is the author's opinion that, as a general rule, hygroscopic agents are not needed if the drying on the slasher is satisfactorily controlled and if there is any consideration paid to air-conditioning in the mill.

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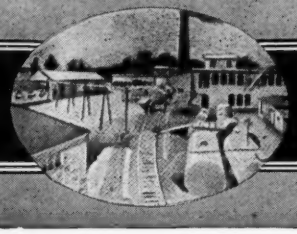

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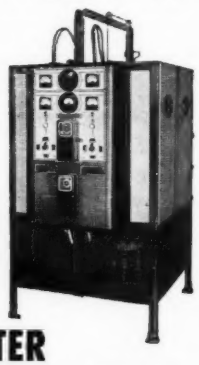

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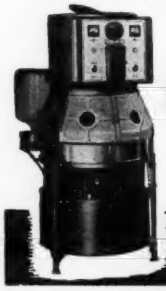

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INDEX TO ADVERTISERS

Althouse Chemical Co.	
Amalgamated Chemical Corp.	VIII
American Aniline Products, Inc.	VI
American Cyanamid Co. (Ind. Chem. D.v.)	Second Cover
American Dyewood Company	
American Key Products, Inc.	XXII
Anders Chemical Corp.	XXIII
Arkansas Company, Inc.	XXVI
Armour and Co.	
Arnold, Hoffman & Co., Inc.	
Atlantic Chemical Co. ,Inc.	XV
Atlas Electric Devices Co.	XX
Becco Sales Corp.	
Bhavanidas Gangadas & Co.	XXV
Bick & Co., Inc.	
Blickman, Inc., S.	
Burkart-Schier Chemical Co.	X
Butterworth Sons Co., H. W.	
Calco Chemical Division American Cyanamid Co.	
Colgon, Inc.	
Campbell & Co., Inc., John	
Carbic Color & Chemical Co., Inc.	XVI
Carbide & Carbon Chemicals Corp.	
Ciba Company, Inc.	
Colgate-Palmolive-Peet Co.	
Commonwealth Color & Chemical Co.	
De Paul Chemical Co., Inc.	
Dewey & Almy Chemical Co.	X
Drew & Co., E. F.	
Du Pont de Nemours & Co., E. I. Dyestuff Division	
Emery Industries, Inc.	
Fallek Products Co., Inc.	
Fancourt & Co., W. F.	
Geigy Company, Inc.	Front Cover
General Chemical Company	VII
General Dyestuff Corp.	III
Girdler Corp., The	
Givaudan-Delawanna, Inc.	
Grinnell Co., Inc.	
Gurley, W. & L. E.	
Hardesty Co., W. C.	
Hart Products Corp.	V
Heyden Chemical Corp.	
Hooker Electrochemical Co.	
Interchemical Corp., Textile Colors Div.	
International Salt Co., Inc.	
Kali Manufacturing Co.	XXII
Kelco Co.	
Laurel Soap Mfg. Co., Inc.	X
Leatex Chemical Co.	
Leeds & Northrup Co.	
Maher Color & Chemical Co.	
Marathon Corp.	
Mathieson Alkali Works, Inc.	
Maywood Chemical Works	
Monsanto Chemical Co.	XII
Myles Salt Co., Ltd.	
National Aniline Division, Allied Chemical & Dye Corp.	Third Cover
National Carbon Co., Inc.	
National Starch Products, Inc.	
Napco Chemical Co.	
Nova Chem. Corp.	XXII
Nuodex Products Co., Inc.	
Nyanza Color & Chemical Co.	
Onyx Oil & Chemical Co.	XIV
Oronite Chemical Co.	
Pabst Sales Company	
Perkins & Sons, Inc., B. F.	
Philadelphia Quartz Co.	
Procter & Gamble	
Proctor & Schwartz, Inc.	
Refined Products Corp.	XXI
Richmond Oil, Soap & Chemical Co., Inc.	XX, XXII
Riggs & Lombard, Inc.	XXV
Rohm & Haas Company	XXVIII
Royce Chemical Co.	Back Cover
Rumford Chemical Works	
Sandoz Chemical Works, Inc.	XIX
Scholler Bros., Inc.	
Sharples Chemicals Inc.	
Smith, Drum & Co.	XXVII
Solvay Sales Corp.	XVIII
Standard Brands, Inc.	
Standard Chemical Products, Inc.	IX
Standard Oil Co. of N. J.	XI
Stein Hall & Co., Inc.	
Tennessee Eastman Corp.	XIII
Titan Chemical Products, Inc.	
Union Carbide & Carbon Corp.	
United Chemical Prod. Corp.	XXV
Van Vlaanderen Machine Co.	
Virginia Smelting Co.	
Wallerstein Co., Inc.	XXV
Warwick Chemical Co.	
Watson-Park Company	XX
Wolf & Co., Jacques	IV
Young Aniline Works	
Young Co., J. S.	XXIII
Zinsser & Co., Inc.	

VIII
VI
d Cover
XXII
XXIII
XXVI
XV
XX
XXV
X
XVI
X
Cover
VII
III
V
XXII
X
XII
Cover
XXII
XIV
XXI
X, XXII
XXV
XXVIII
Cover
XIX
XXVII
XVIII
IX
XI
XIII
XXV
XXV
XX
IV
XXIII
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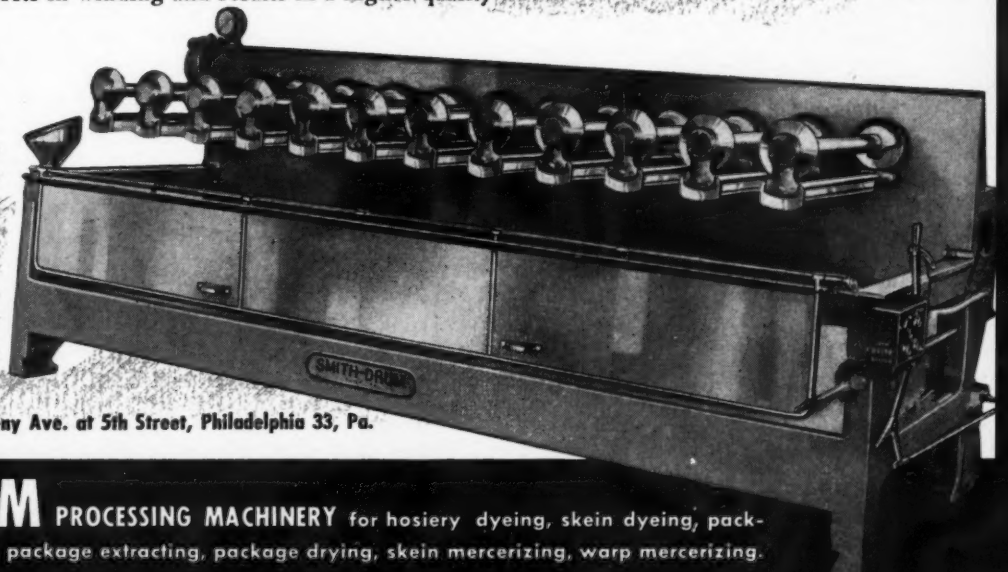

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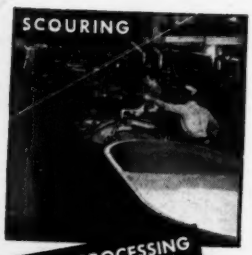

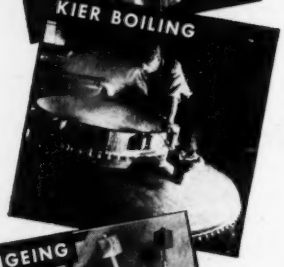

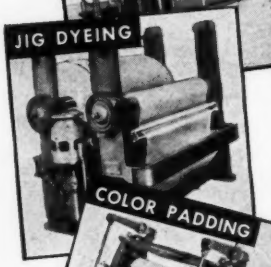

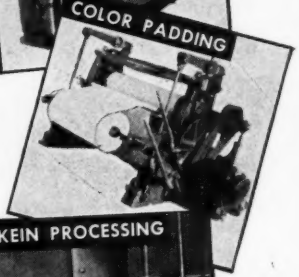

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